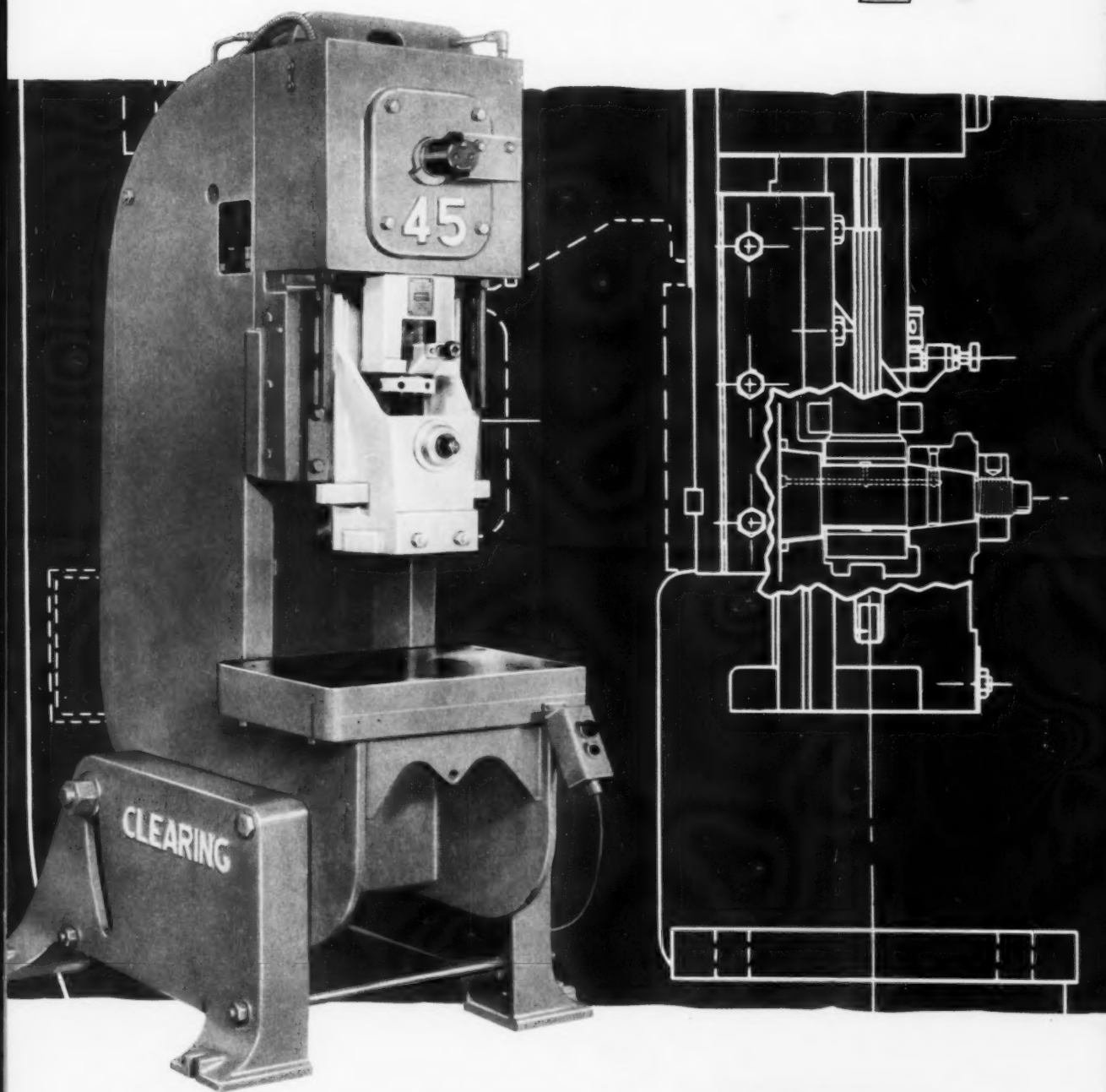


Machinery



***Clearing Blueprints the
Future in O.B.I. Presses
See Advertisement Page 37***





CONTOUR BORIZING...

Adding Accuracy for Tape Control

by R. W. Mason
Chief Inspector
The Heald Machine Company

Three years of design and manufacturing experience and an outstanding background of performance records, on tape-controlled Model S Bore-Matics, have made two things clearly evident.

First — accuracy and reliability of these contour Borizing machines have proved to be outstanding. Tolerances of $\pm .0001$ are repeatedly obtained in routine production.

Second — these results stem from a design and manufacturing accuracy which produce a unique machine capable of utilizing the full potential of today's most advanced numerical control systems.

To obtain this accuracy in building the machine, unusual manufacturing and assembly procedures are required and exceptional quality control and inspection techniques are employed. Some of these are of particular interest.

To prevent dimensional changes due to thermal effects during machine assembly, all work is done under controlled temperature in an air-conditioned room. To prevent strain and distortion, all screws on critical assemblies are tightened with torque wrenches to pre-determined design pressures.

All elements of straightness, alignment and tracking are measured with an Auto-Collimator which compares the work to a beam of light and reads to an accuracy of 0.1 of a second of arc (one second of arc is equal to .000005 per inch of length). All dimensional measurements are made with electronic indicators.

Hardened steel ways are assembled and honed in place to a straightness of .000050 or less, in their full length. Table and cross slide are actuated, in increments as small as .000025, by high-precision pre-loaded anti-friction ball screws. Bearing diameters for these ball screw assemblies are bored and honed *in place* on the machine, to assure precise alignment with the ways.

Tracking along each of the two axes is measured in two planes — horizontal and vertical — and must be accurate within .000025 in their full length of travel.

Obviously control measures such as these are not conducive to mass-production methods or other cost-cutting expedients. However, the results are well worth the extra effort. These machines track and repeat to the full potential of the numerical control system, sustaining production required for today's high precision contour boring and turning operations.



Heald tape-controlled Model S Bore-Matic for boring and turning irregularly-shaped work with a dimensional accuracy of $\pm .0001$ or better.

It PAYS to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.
 WORCESTER 6, MASSACHUSETTS

Machinery

JULY 1961

VOL. 67 No. 11

**THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION
IN THE MANUFACTURE OF METAL PRODUCTS**

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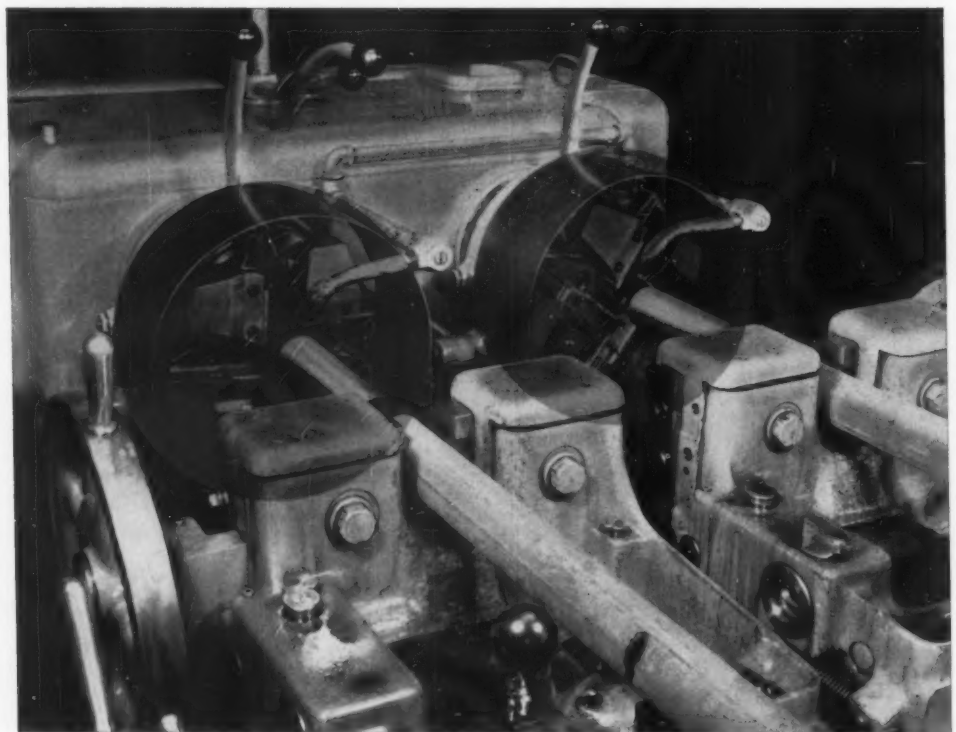
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*One pass heavy duty
threading with*
LANDMACO MACHINE



LANDMACO Threading Machines prove daily to be ideal for cutting coarse pitch threads in one pass. We illustrate here the excellent results obtained by using a 21½" 20C LANDMACO Double Spindle Threading Machine at WACO Manufacturing, Cleveland, Ohio.

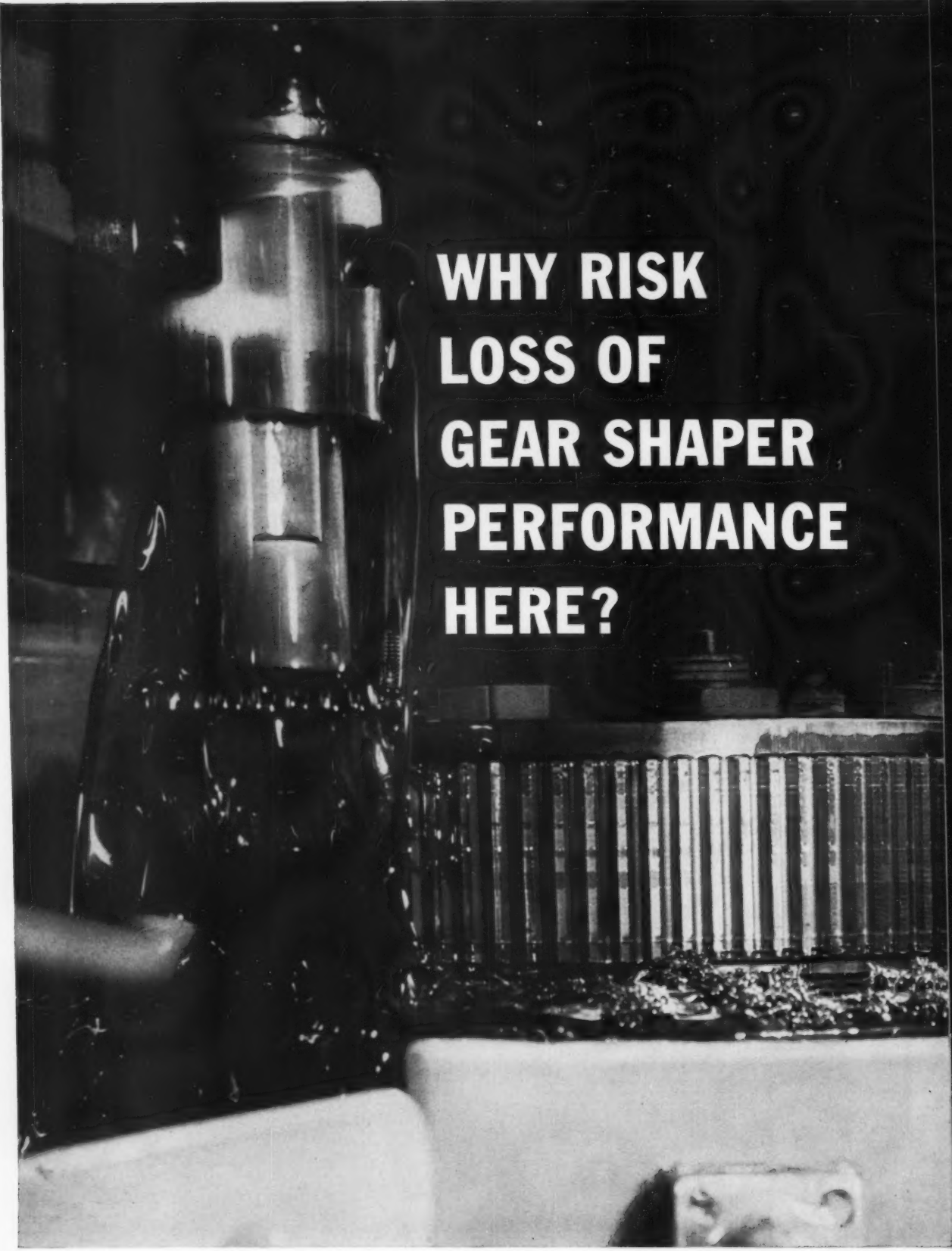
Equipped with a 21½" Type R LANCO Heat Treated Die Head, the LANDMACO cuts 23⅝", 4 Pitch Modified Acme threads on Black Pipe 8½" long at a cutting speed of 34 R.P.M. 31 pieces are threaded per hour per each spindle. Despite the large amount of metal removal, chaser life is good with 248 pieces produced between grinds for each spindle, equal to 8 hours operation.

LANDMACO machines are especially suited for the cutting of Acme threads. The 21½" LANDMACO features heavy construction, hardened-and-ground ways and lead screw attachment. Although equipped with a Heat-Treated Head in the WACO application, the LANDMACO may be used with Hardened-and-Ground LANCO Die Heads. This Machine's diametrical range is ½" to 21½" with other LANDMACO models available to cover all ranges from ¼" to 65⅝". For more detailed information please send specifications when writing.

LANDIS Machine COMPANY WAYNESBORO • PENNSYLVANIA
THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT



813C



**WHY RISK
LOSS OF
GEAR SHAPER
PERFORMANCE
HERE?**

Give your products all the high-production, high precision advantages of Fellows Gear Shaper performance by tooling up with Fellows cutters.

The better design of Fellows cutters is the result of advanced engineering techniques, including the use of a high-speed computer for solving design and application problems. Their better quality is the result of constant advances in metallurgy and manufacturing methods. And, proof of their better performance are the thousands of Fellows cutters in use on modern gear production lines.

Fellows cutters on Fellows machines lower costs and speed production on external and internal, spur and helical involute gears and a wide variety of non-involute shapes as well. All Fellows Offices are at your service for providing information.



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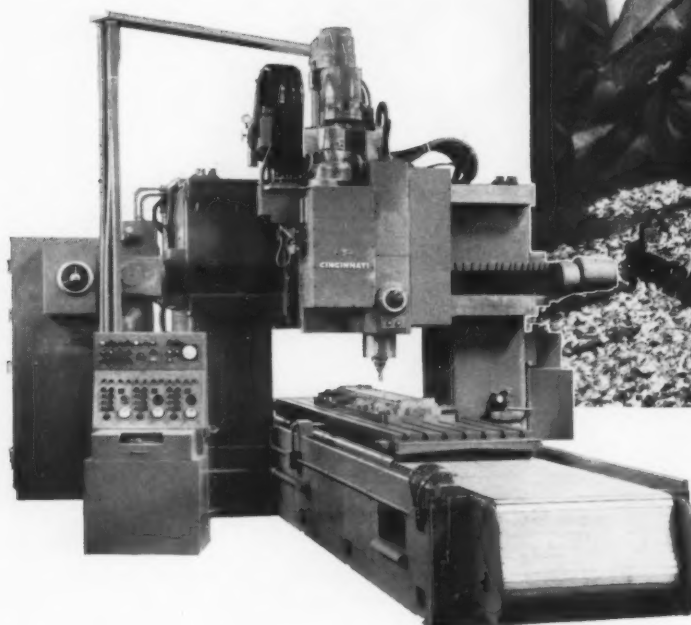
1048 North Woodward Ave., Royal Oak, Mich.
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THE
PRECISION
LINE

Fellows

Gear Production Equipment

A New Generation of



Designed for numerically controlled milling. This new CINCINNATI 36" x 120" Bridge-Type Profile and Contour Milling Machine automatically mills the pockets of an aircraft wing inner panel beam. The machine is one of several built to perform a variety of aerospace and general purpose milling operations.

DESIGNERS AND BUILDERS OF SPECIAL MACHINES • HORIZONTAL BROACHING MACHINES •
THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

Machines **built by** CINCINNATI

**SPECIAL
MACHINE
DIVISION**

**... has everything required for
numerically controlled milling**



Aircraft wing inner panel beam, an example of complex parts machined at low cost by the CINCINNATI Numerically Controlled Milling Machine illustrated at the left.

Numerical control is the boss; it tells the machine exactly what to do at a particular time. But to perform the task accurately, the machine must be equipped to follow instructions without benefit of a highly skilled operator. Cincinnati's Special Machine Division blends all requirements for ultra-modern metalworking equipment in the new Bridge-Type Profile and Contour Milling Machines. They're a new generation of machines, new from the ground up; designed specifically for numerically controlled milling on a variety of parts made of aluminum, titanium, steel and the new "exotic" materials.

The machine is a closed cantilever construction, assuring extra rigidity throughout, to give you full potential of the numerical control system.

Constant speed hydraulic motor drive for the spindle provides full torque throughout entire range of speeds.

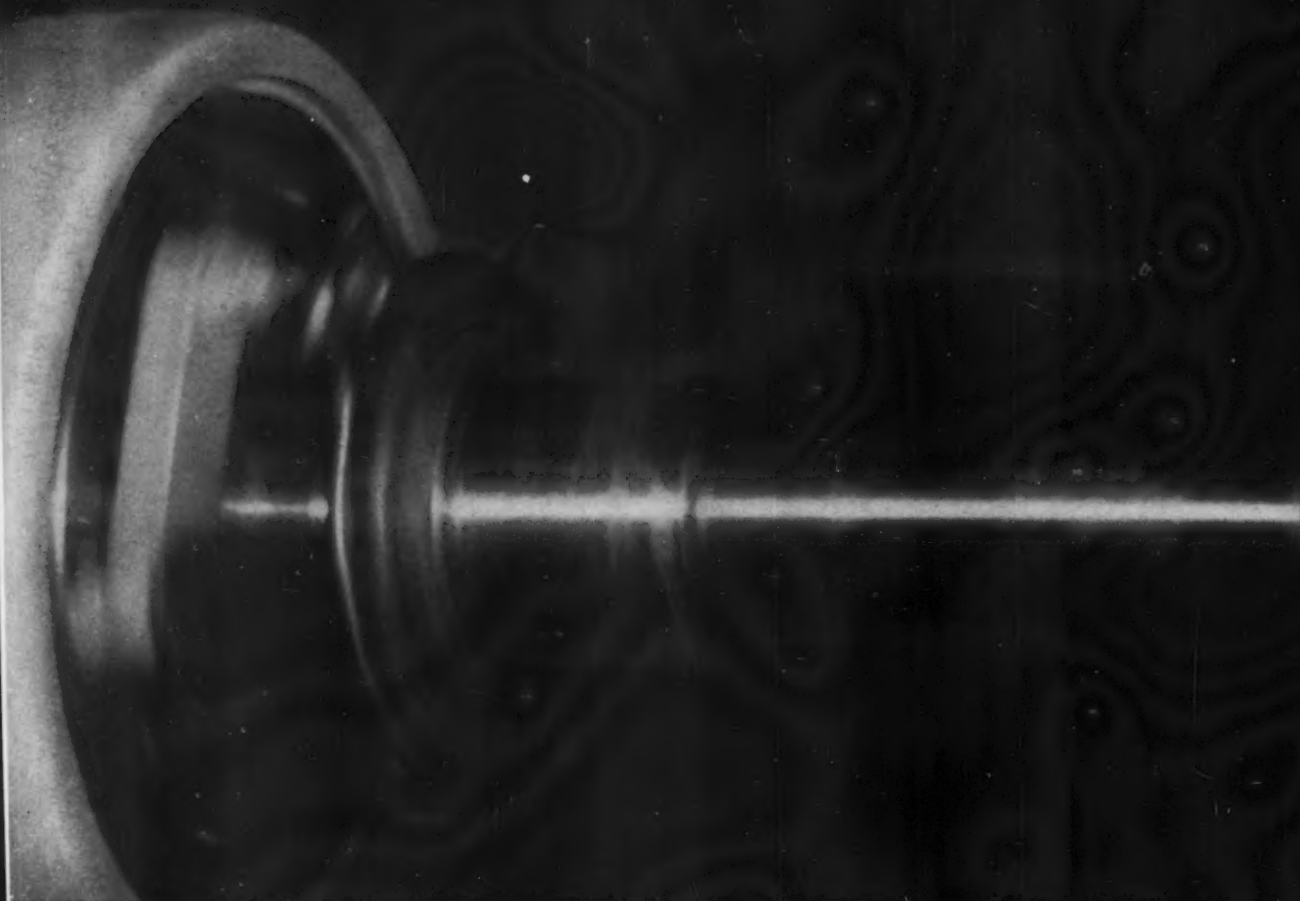
Wide range of spindle speeds (in 24 or 26 steps) and feeds ($\frac{1}{4}$ to 100 ipm), allows complete freedom in changing from one basic metal to another. "Building Block" construction gives you a choice of several table widths and any practical table travel starting at 48".

Every type of equipment built by Cincinnati Milling's Special Machine Division is considered as a completely coordinated production unit capable of reducing costs, machining an "impossible" job and/or improving quality. Our specialists want to know about your metalworking problems. May we hear from you?

COMPLETELY AUTOMATED PRODUCTION LINES

CINCINNATI®

SPECIAL MACHINE DIVISION

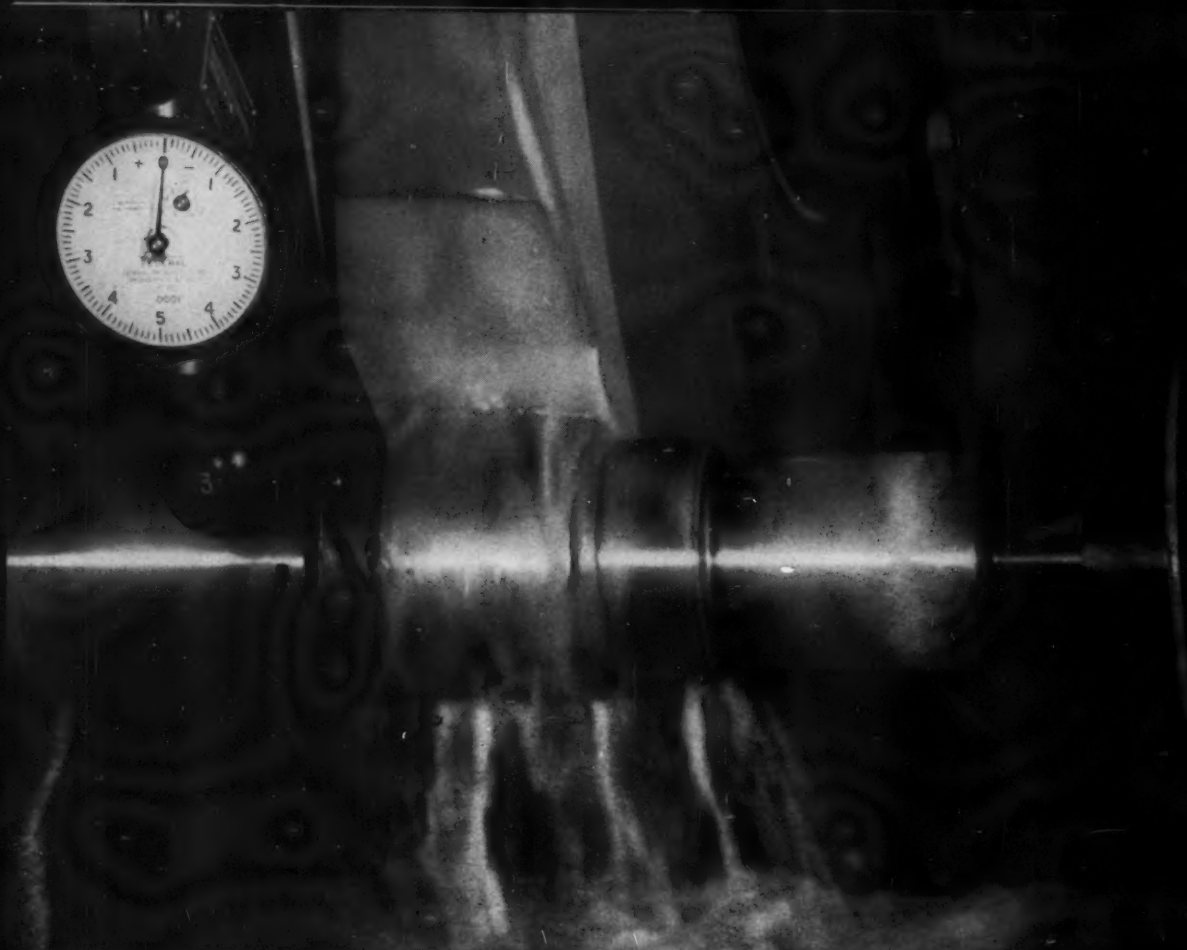


Landis Size Finder cuts time

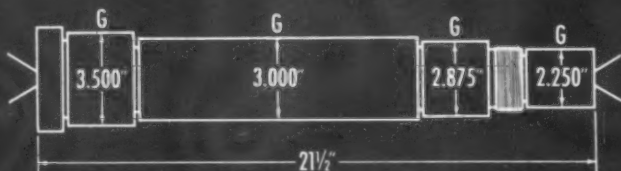


Ad #258

**Landis 10" x 36" Type R Plain
with Size Finder and Microfeed®**



60% grinding these 4 diameters



production data

Tolerance	± .0001"
Material	SAE 4140
Conventional grinding time	15 min. per shaft
Size Finder grinding time	6 min. per shaft
Time saved per shaft	9 minutes

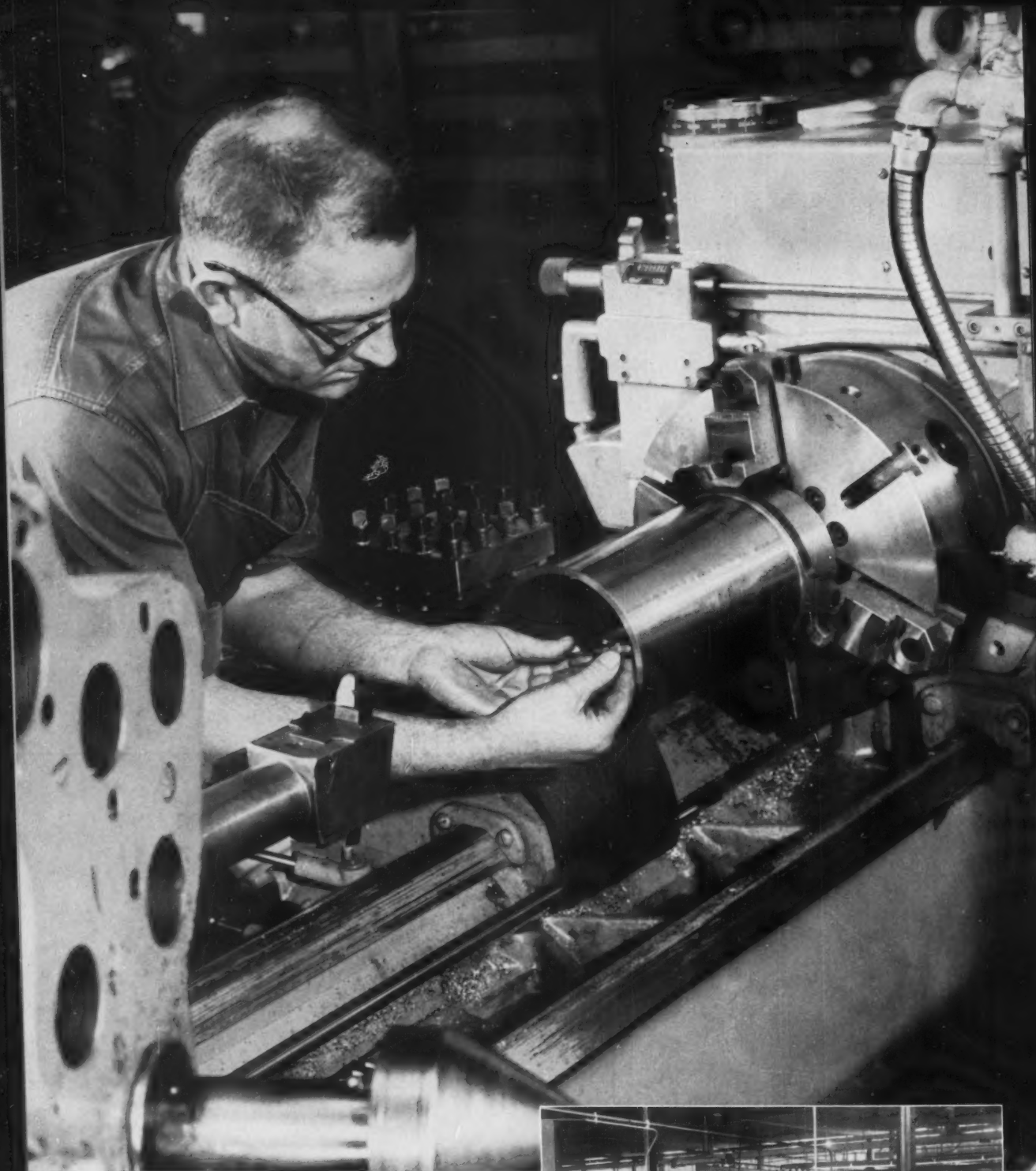
size finder

For fast and accurate grinding of multiple diameter shafts to close tolerances, operator sets size finder dial indicator to required finish diameter. Microfeed advances wheelhead in fine increments after sparkout until finish size is shown on gage.

LANDIS

world leader in precision grinders

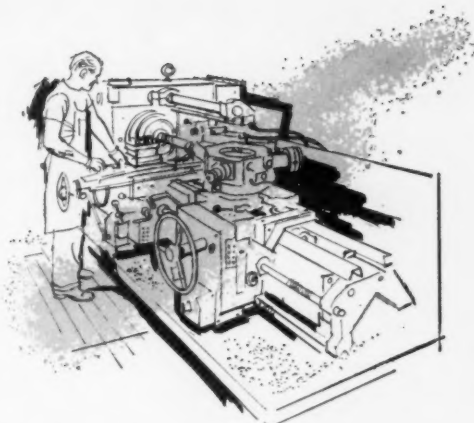
LANDIS TOOL COMPANY, WAYNESBORO, PA.



Canning Machinery Division's turret lathe department after modernization. Ten new machines like these replaced 14 old ones 16 to 19 years old. Result: labor costs dropped 50%; scrap loss down 65%; maintenance cut 70% plus many other benefits such as better operator morale. FMC found direct benefits became available from replacing all turret lathes at once, which are not ordinarily obtained with one-machine-at-a-time replacement.

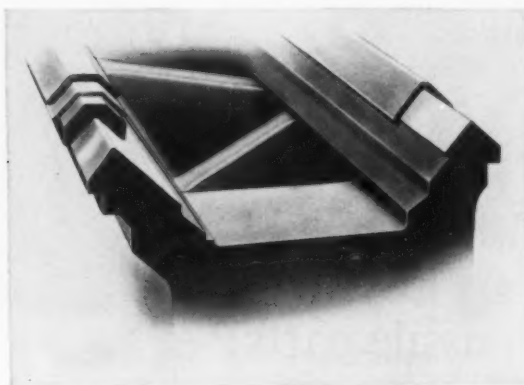


AT CANNING MACHINERY DIVISION
Food Machinery and Chemical Corporation
Hoopeston, Illinois, Plant



2-A Turret Lathe bores stainless steel cylinders to .001" tolerance

Warner & Swasey 2-A Turret Lathe provides the necessary feeds and speeds, power and rigidity for handling critical jobs in tough work materials



Accurate Vee-Ways. Precision ground ways are induction hardened for long-term accuracy. Extra protection is provided by patented telescoping way-covers which prevent damage from heavy objects, scoring by grit and chip particles, and loss of lubrication on the ways from coolant splash,

Long cuts in tough materials to close limits of size and finish, see typical cylinder illustrated, pose no problem to Canning Machinery Division's battery of new Warner & Swasey turret lathes.

These machines have more and higher speeds, more power and precise optical alignment of the spindle with the precision ground self-guiding "Vee-ways". In addition, engineered placement of gibs, and distribution of weight through casting sections produce the ruggedness and rigidity needed for heavy roughing cuts in the same operation with the precision finishing cuts. As this company found, old equipment simply can't compete with the new Warner & Swasey's on the "problem jobs". For full information on the line of new Warner & Swasey turning equipment, why not contact the trained Field Engineer in your area. Warner & Swasey Company, Cleveland 3, Ohio.

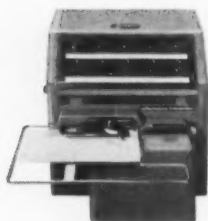
**YOU CAN TURN IT BETTER, FASTER,
FOR LESS...WITH A WARNER & SWASEY**



How Convair-Astronautics keeps track of this...



(and 84,999 other missile parts)



The Manufacturing Control Department at Convair (Astronautics) Division of General Dynamics Corporation has a monumental problem: how to keep track of the movement of over 85,000 individual missile parts.

The solution: *automated data preparation* by means of a Friden Collectadata® system. Situated in key plant locations, Collectadata transmitters report virtually all parts movements—over 5000 every day—to central Collectadata receivers which record them into punched paper tape. At day's end the Collectadata tapes are fed into the electronic computer at Astronautics for further data processing.

This is what Astronautics says: "*The Collectadata has been in use at Astronautics for less than a year. But by eliminating tedious manual paperwork, and by assuring prompt processing of all inventory reports, it has already saved considerable time, trouble and money.*"

How much could Collectadata save you? Call your Friden Systems Man, or write: Friden, Inc., San Leandro, Calif.

THIS IS PRACTIMATION: automation so hand-in-hand with practicality there can be no other word for it.

Sales, Service and Instruction
Throughout the U.S. and World

Friden

MACHINERY, July, 1961

Gardner solves problem of grinding unequal areas with two disc specifications

discs with different bonds and structure permit high production grinding to desired tolerances

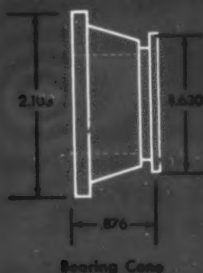


Gardner BGR disc specification

- wider grain spacing
- deep grain penetration
- effective chip clearance

Gardner BKGR disc specification

- fast stock removal
- cool cutting
- effective chip clearance



Call the Gardner Abrasives Specialist for practical solutions to your disc grinding problems.

GARDNER
abrasive discs
BELOIT, WISCONSIN

Ex-Cell-O Model 922 Numera-Trol ...

PRECISION IN MILLIONTHS PLUS COMPLETE VERSATILITY!

Interchangeable, self-contained units provide a universal, tape-controlled "production center" for ...

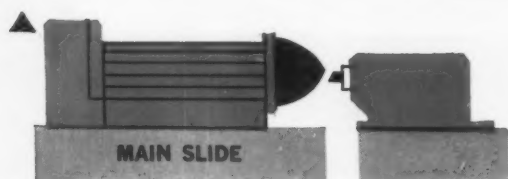
- ... Single and Double-spindle Boring and Turning
- ... Templet Grinding and Scribing
- ... Flat Circular Cam Grinding
- ... 3-Axis Vertical Contour Milling

Ex-Cell-O's Model 922 Numera-Trol Machine gives you extremely broad design and manufacturing capabilities in a single production machine tool controllable to 25 millionths of an inch.

Interchangeable precision machining units mount

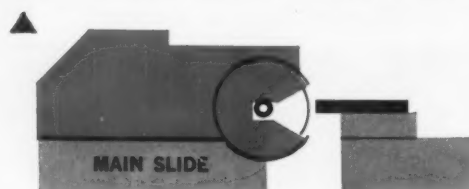
on the main slide, and simply "plug in" to the machine's hydraulic, electrical and continuous-path numerical control circuits. In most cases, the Model 922 can be completely retooled and ready for entirely different, fully-automatic production in a few hours.

Send today for engineering and performance data, or call your Ex-Cell-O Representative for complete specifications.



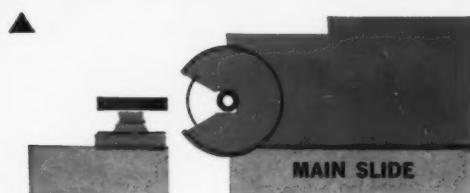
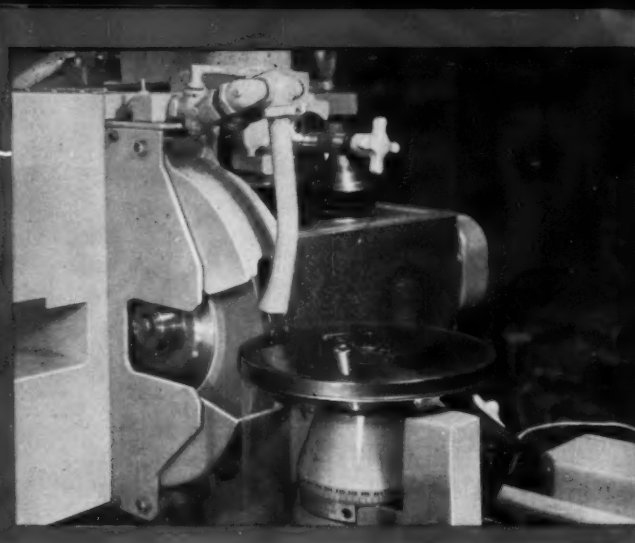
Single and Double-Spindle Turning-Boring Unit

- Variable-speed workheads on main slide maintain constant surface speeds.
- Manual or automatic control of slides in .000025" increments.



Templet Grinding-Scribing Unit

- Accommodates wheels up to 12" diameter on main slide.
- Manual or tape-controlled wheel dressing, size compensation and cycling.



Flat Circular Cam Grinding Unit

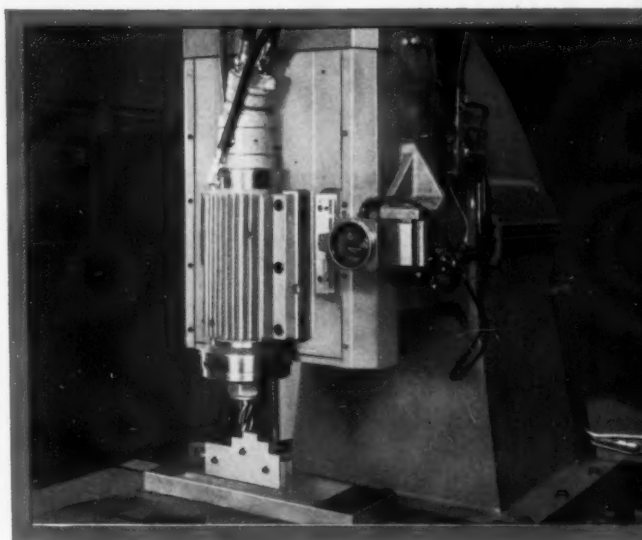
- Adjustable, vertical-oscillating wheel spindle for flat-edge grinding.
- Tape-controlled rotary indexing fixture on cross-slide.

3-Axis Vertical Contour Milling Unit

- 6" vertical column movement, 18" main slide travel, 26" cross-slide travel.
- Designed for extremely close-tolerance contour milling and die-sinking.



There's a Series 900 Numera-Trol to meet your most difficult jobs! Contact your Ex-Cell-O Representative, or write for literature on tape-controlled Ex-Cell-O Series 900 Numera-Trol Machines: Models 905 and 920 for both hemisphere and free-form boring and turning; Model 924 for grinding flat circular cams; the universal Model 922; and the Model 952 drum-cam and blade contouring machine.

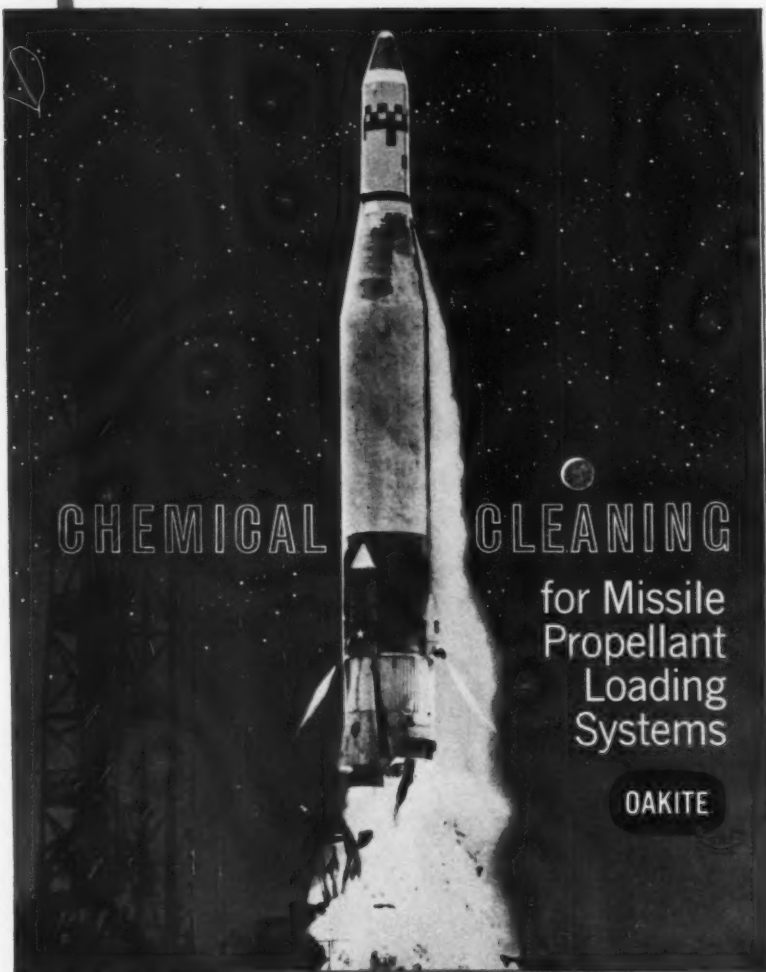


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Machinery Division

EX-CELL-O
CORPORATION
DETROIT 22, MICHIGAN

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BULLETIN
 on successful
 cleaning of
MISSILE
PROPELLANT
SYSTEMS



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Bulletin explains why removal of all soil larger than .0004 inch is a job for a cleaning expert . . . tells how to obtain the services of that expert at no cost to you. Ask your local Oakite man for a copy, or write Oakite Products, Inc., 26 Rector Street, New York 6, N. Y.

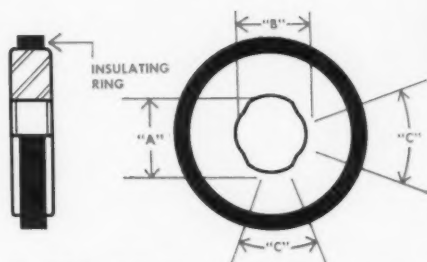


over **50** years' leadership in industrial cleaning
 Est. 1909



Using air gages?

this Bryant 2-D master setting ring speeds inspection, cuts gage needs in half!



1. Slide 2-D Gage over pneumatic plug. Adjust air gage indicator to high or low limit on scale, corresponding to "A" (max. dia.) or "B" (min. dia.).

2. Rotate 2-D Gage to its second diameter. Repeat gage calibration.

Surface finish within 40° working areas "C" is 4 micro-inch (RMS) or better.



Here's what you can do with the 2-D Master Setting Ring Gage . . .

- Reduce cost and inventory of master setting rings
- Calibrate spindle-type air gages faster than ever
- Control high and low indicator drift with one master ring
- Check wear of different-size pneumatic plugs with one gage

Bryant 2-D Master Setting Ring Gages are made to your required product tolerances, within Class X gage accuracy. Because there's no need for a pair of masters, your costs and inventory go down. Because there's no wasted gaging motion, your inspection efficiency goes up!

Available in standard sizes from .365" to 2.510" I.D.; special sizes made to order. Call or write direct for price and size data.

61-638


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EX-CELL-O
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CHAMBERSBURG



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AUTOMATIC FORGING IN JOBGING LOT QUANTITIES

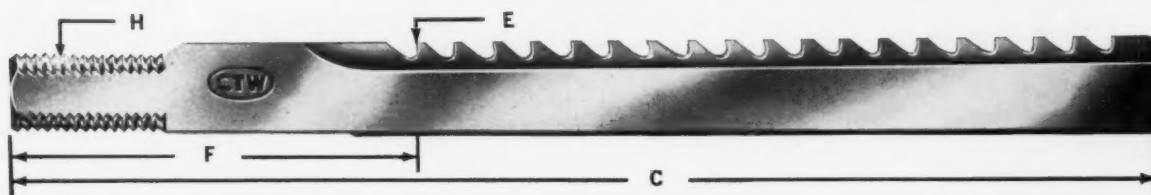
Made possible by the **MODEL "C" IMPACTER**
with a unique program-controlled Feed Device

A "BREAKTHROUGH" IN THE MECHANIZATION OF THE DROP FORGING PROCESS

Write for new bulletin No. 110-L-1 "Chambersburg Cecomatic
Process for the Jobbing-Type Production of Drop Forgings"

CHAMBERSBURG ENGINEERING COMPANY • CHAMBERSBURG, PA.

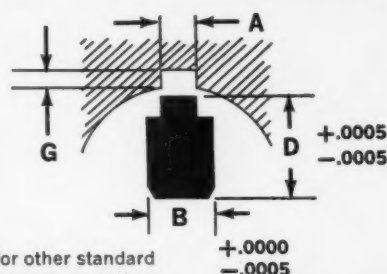
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Continental now stocks a popular range of standard keyway broaches to help you meet production schedules faster than ever, and to let you cut your tool inventory.

Just call your CTW Representative, or order by catalog number direct from Continental. The broaches you need are in stock now—ready for immediate delivery to your plant!

Sizes listed below are available for immediate delivery. See the CTW Catalog for other standard broaches. Special sizes quickly made to order. Send your print for a prompt quotation.



BROACHING INDUSTRY SERIES

Catalog Number	A Keyway Width			Min. Hole Size	Min.† Length Cut	Max. Length Cut	Width of Body B	Total Broach Length C	Height at Last Tooth D	Height at First Tooth E	Length of Shank F	Keyway Depth in Part G	No. of Cuts	Thread H
	Nom. Dim.	Decimal Dim.	Tolerance											
502	3/32	.0948	±.0002	7/16	1/2	1 1/2	.1865	24	.367	.309	8 1/4	.058	1	5/16-18
504	1/8	.126	±.0002	1/2	1/2	1 1/2	.249	30	.438	.364	9	.074	1	3/8-16
505	1/8	.126	±.0002	11/16	3/4	2 1/2	.3115	36	.594	.520	10	.074	1	1/2-13
508	3/16	.1885	±.0002	11/16	3/4	2 1/2	.374	36	.581	.476	10	.105	1	1/2-13
512	1/4	.251	±.0002	11/16	3/4	2 1/2	.374	36	.612	.476	10	.136	1	1/2-13
513	1/4	.251	±.0002	1	11/16	4	.499	45	.877	.741	11 11/16	.136	1	3/4-11
514	1/4	.251	±.0002	1 1/16	3/4	6	.624	51	1.250	1.114	13 1/2	.136	1	3/4-10
517	5/16	.314	±.0002	1	11/16	4	.499	45	.908	.741	11 11/16	.167	1	3/4-11
519	3/8	.3765	±.0002	1 1/16	3/4	4	.499	45	.938	.739	11 11/16	.199	1	3/4-11
520	3/8	.3765	±.0002	1 1/16	3/4	6	.499	54	1.189	.990	13 1/2	.199	1	3/4-11
523	1/2	.5015	±.0002	1 1/2	11/16	4	.624	48	1.312	1.051	12	.261	1	3/4-10
524	1/2	.5015	±.0002	1 1/2	1	8	.624	48	1.377	1.246	16 1/2	.261	2	3/4-10

ORIGINAL CTW SERIES

CTW 7	3/16	.1885	±.0002	11/16	1/2	2 1/2	.375	36	.581	.480	9	.101	1	1/2-13
CTW 10	1/4	.251	±.0002	11/16	3/4	2 1/2	.375	38	.612	.480	9	.132	1	1/2-13
CTW 11	1/4	.251	±.0002	1	11/16	3 1/2	.500	44	.877	.740	10	.137	1	3/4-11
CTW 14	5/16	.3135	±.0002	1	11/16	4	.500	46	.908	.740	10 1/2	.168	1	3/4-11
CTW 17	3/8	.376	±.0002	1 1/16	11/16	4	.500	46	.938	.740	10 1/2	.198	1	3/4-11
CTW 23	1/2	.501	±.0002	1 1/2	11/16	3 1/2	.625	46	1.422	1.160	10	.262	1	3/4-11

ORIGINAL XLO SERIES

XLO 3	3/16	.1885	±.0002	1 1/2	1 1/2	1 1/2	.250	28	.541	.438	8 1/4	.103	1	3/8-16
XLO 5	3/16	.1885	±.0002	3/4	3/4	2	.375	28	.541	.438	8 1/2	.103	1	1/2-13

† MINIMUM LENGTH OF CUT RECOMMENDED TO PREVENT PART FROM DROPPING BETWEEN TEETH OF BROACH

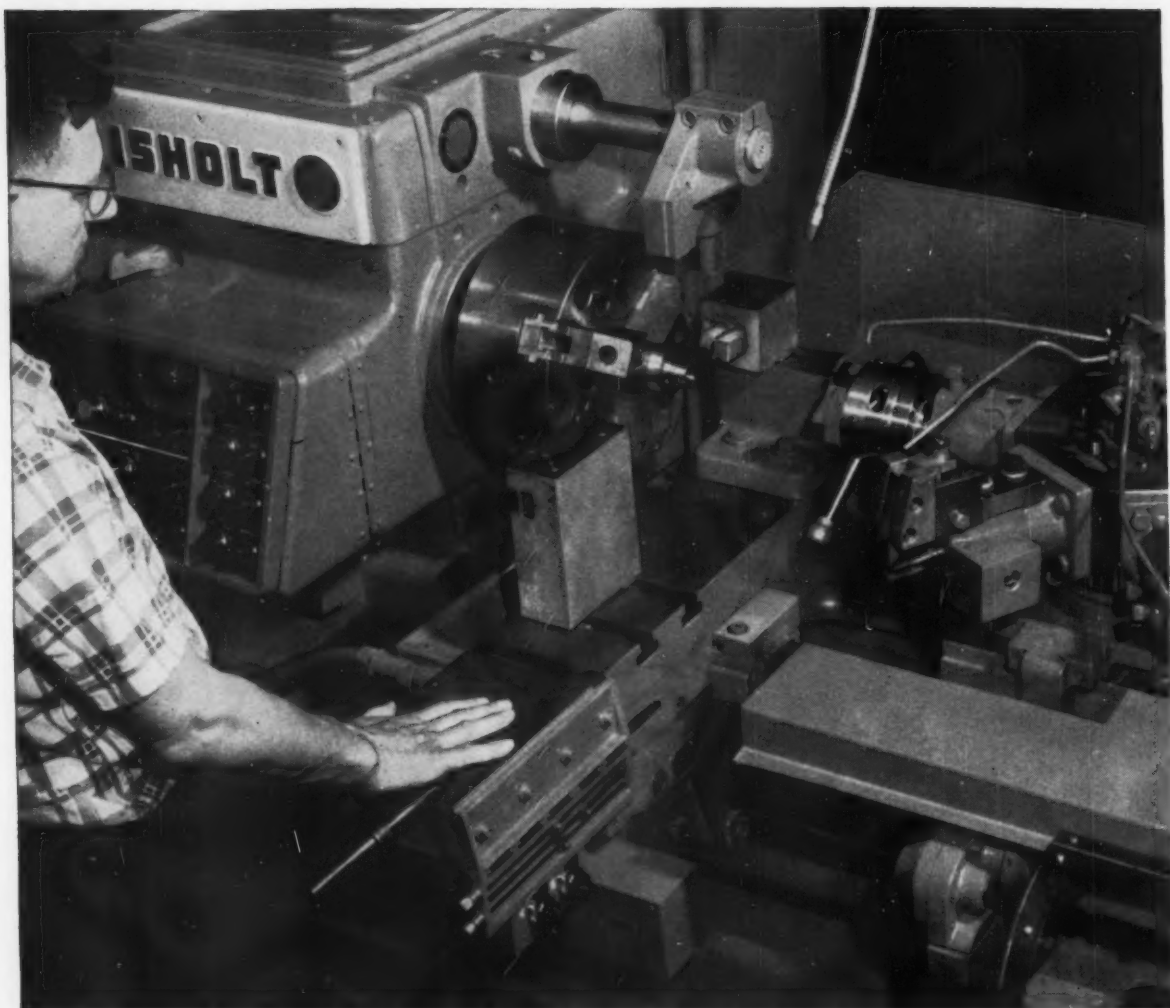






61-33C

DETROIT 32, MICHIGAN



Automatic cycling Gisholt 5AR handles variety of bar and chucking tasks, depends on nickel alloy steels for resistance to heavy stress and wear.

Three nickel alloy steels give Gisholt 5AR extra strength for precision metalworking

Here's where Gisholt engineers specify nickel steels to insure close-tolerance machining with the MASTERLINE® 5AR Turret Lathe:

Chuck screws are made of **AISI 3312** carburized to a case depth of .015" and hardened to 60 Rc min. This 3½% nickel steel resists chipping or breakage when the screws are tightened by hand or hammer. The strength and toughness of AISI 3312 steel well match the severe torsional and compressive loads that are brought to bear as the workpiece is locked in place and machined.

Headstock gears in the 5AR lathe are **AISI 4620** carburizing steel (1.8% nickel). Readily heat-treated to a sur-

face hardness of 60 Rc, 4620 develops average core properties of 135,000 psi tensile strength and 105,000 psi yield strength. Gears made of this steel survive the highest tooth loads and abrasive wear.

Spline shafts are made of **AISI 4340**. This 1.8% nickel through-hardening steel provides excellent strength in an extremely tough core for shafts subject to high torsional stresses. Oil-quenched and tempered to a tensile strength of over 200,000 psi, AISI 4340 develops consistent strength and

toughness in parts having varied section size.

When you design, order or use heavily stressed parts for machine tools, count on the strength and toughness of nickel alloy steels. And for engineering data on these steels to help you select the best combinations of case and core properties, write to Inco. We'll be glad to help. *Reg. trademark

THE INTERNATIONAL NICKEL COMPANY, INC.

67 Wall Street



New York 5, N. Y.

INCO NICKEL

NICKEL MAKES ALLOYS PERFORM BETTER LONGER

EX-CELL-O SPINDLES



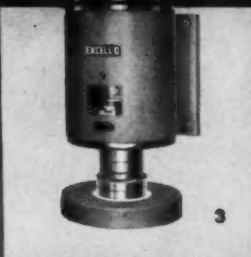
RUN TRUE



1



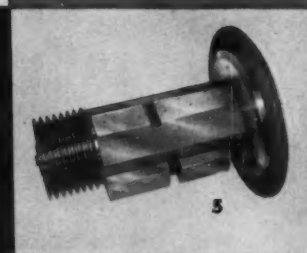
2



3



4



5

1. High-frequency, 25,000 rpm motorized type.
 2. Cutter grinder model; 3600 rpm inbuilt motor.
 3. Vertical units fit many power requirements.
 4. I.D. type adapts to most machines.
 5. Form grinder spindle; 25 h.p. capacity.
- Cross-section drawing (above right) of single-row bearing shows points of ball contact (A, B and C) on tracks in race.

59-27

EXCLUSIVE RADIAL THRUST BEARING DESIGN PUTS PRECISION INTO PRODUCTION GRINDING

What makes Ex-Cell-O Precision Grinding Spindles run true? Engineering experience, skill in precision production and assembly, quality materials—and perhaps most important, the famous Ex-Cell-O Precision Spindle Bearing!

Made by Ex-Cell-O for use only in Ex-Cell-O Spindles, this custom-made bearing is the product of a unique Ex-Cell-O process which develops tracks or pathways in the race. The ball contacts the race only at these narrow, mirror-smooth bands (see detail above).

As a result, the bearing runs cooler at high speeds; wear is reduced, rigidity is improved, and spindle accuracy is measurably increased.

In widespread original equipment use, Ex-Cell-O Spindles are also an economical means of increasing

speed and accuracy in older I.D. or O.D. surface and thread grinders, tool and gear grinders and similar equipment.

See your Ex-Cell-O Representative, or write direct for details on the complete line of Ex-Cell-O Precision Grinding and Boring Spindles.

EX-CELL-O FOR PRECISION

EX-CELL-O
CORPORATION
DETROIT 32, MICHIGAN

XLO

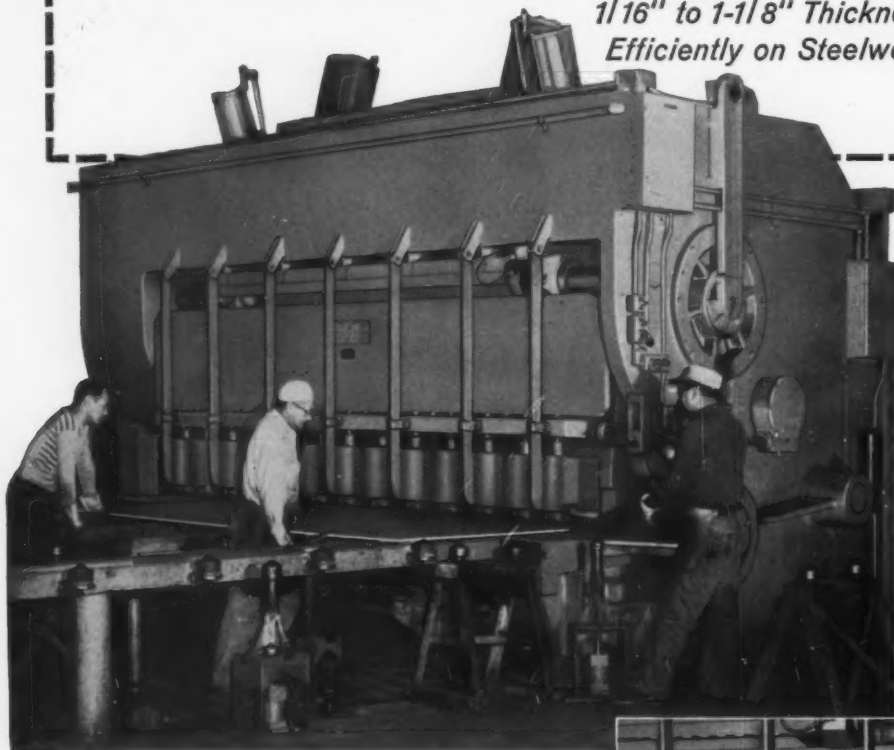
Machinery

Division

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS
RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE
COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES
AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS
AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY
EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

1000 Tons High Alloy Steels **PRECISION-SHEARED** Monthly

*1/16" to 1-1/8" Thicknesses Cut
Efficiently on Steelweld Shear*



Steelweld mechanical shear No. 24GA-12 cutting a 9/16" x 124" plate of 304 chrome nickel.

Some interesting details of this machine:

Capacity 1 1/2" x 12'-0" mild steel — 8" stroke — 21 strokes per minute — 48" motorized back gauge — 20'-0" squaring gauge arm — 7'-0" front gauge outriggers — slitting guide — centralized lubrication system — air-operated ball transfers.

Adjusting gap between knives to provide correct clearance for plate thickness being cut. This adjustment is made in seconds, not hours, as required for some shears. Indicator has scales reading in plate thicknesses and in thousandths of an inch knife clearance. Note convenient up-front location of this important feature.

Addition of a Steelweld Shear boosted shearing capacity tremendously for Jessop Steel Company, Washington, Pa. More than 1000 tons of fine quality stainless, tool, high-speed and related alloy steels for which this 60-year old producer is noted, are sheared monthly on this machine — and every cut is sharp, straight, accurate.

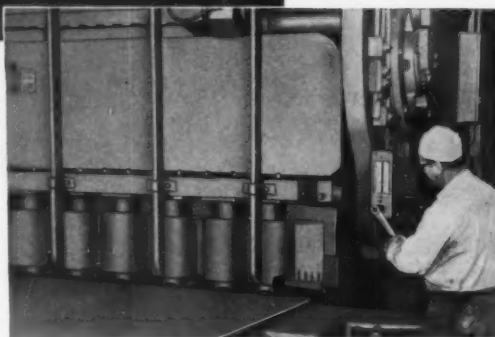
The shear works continually 16 hours a day, 5 days a week, cutting thicknesses from 1/16 to 1 1/8 inch. Frequently plate up to 240 inches long are slit by use of the Steelweld slitting arrangement.

The three Steelweld features most impressive to Jessop officials are:

1. The fast easy knife adjustment which can be quickly set to provide the best cut for every plate thickness.
2. The immediate, positive operation and long trouble-free life of Steelweld's air-cooled clutch and brake.
3. The massiveness and rigidity built into the frame and all working parts.

Jessop Steel has found that knives last three times as long on its Steelweld because of the knife adjustment feature. This means an important saving in knife costs, as well as a big reduction in down-time normally required for rotating or changing knives.

"A very fine operating shear" . . . "A machine that is doing a good job for us" . . . These are some of the comments of Jessop Steel production executives.



Steelweld Shears are available in all sizes for cutting steel plate to thicknesses of 2" and in lengths to 30'-0".

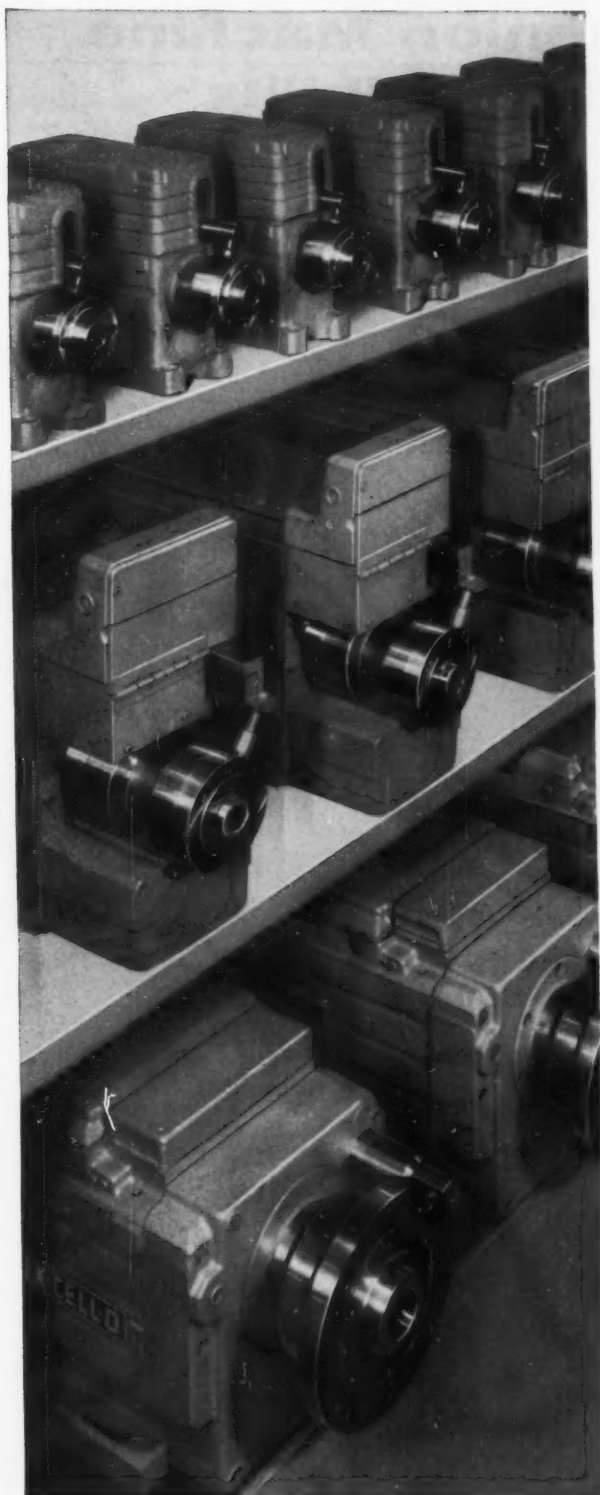
Write for free copy of catalog No. 2011

STEELWELD
PIVOTED
BLADE
Mechanical and Hydraulic
SHEARS



Steelweld Machinery includes: Mechanical & Hydraulic Shears and Press Brakes, One-, Two- and Four-Point Straight-Side Presses, Speed-Draw Presses.

STEELWELD MACHINERY DIVISION • THE CLEVELAND CRANE & ENGINEERING CO. • 5464 E. 282 ST. • WICKLIFFE, OHIO



NEED Power Units in a Hurry?

**Ex-Cell-O gives you
off-the-shelf delivery!**

In stock for immediate delivery, Ex-Cell-O Hydraulic Power Units are available in four quill-type models offering a wide range of spindle speeds, horsepower, stroke and thrust.

Self-lubricating for low maintenance, and precision-built for long life, Ex-Cell-O Hydraulic Power Units, and our Canadian-built lead-screw type Tapping Unit, are designed for drilling, reaming, tapping, spotfacing and other single or multiple operations, and for heavy-duty boring and milling machine applications. Pre-set start, rapid approach and return, dwell, reverse and stop are fully automatic.

Your Ex-Cell-O Representative has complete specifications, or write direct for our catalog. The model you need is on the shelf now—ready for same-day shipment to your plant!

61-21MA

EX-CELL-O FOR PRECISION

PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • JIG AND FIXTURE COMPONENTS • TORQUE ACTUATORS • CONTOUR PROJECTORS
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Machinery Division

EX-CELL-O
CORPORATION
DETROIT 32, MICHIGAN

New Cross Trunnion Machine with Greater Flexibility

► *Processes remote accessory cylinders of
different designs and different materials* ◀



Another Automation First by Cross

Recent developments by Cross have resulted in trunnion machines that perform a variety of operations on families of parts with improved accuracy and at a higher rate of production than previous equipment.

A typical application of the new design concept is the processing of remote accessory cylinders which vary in both size and material. Different lengths are handled by changing a few tools, replacing some fixture details and adjusting the feed strokes. Both modular and grey iron castings are processed by changing the speeds and feeds.

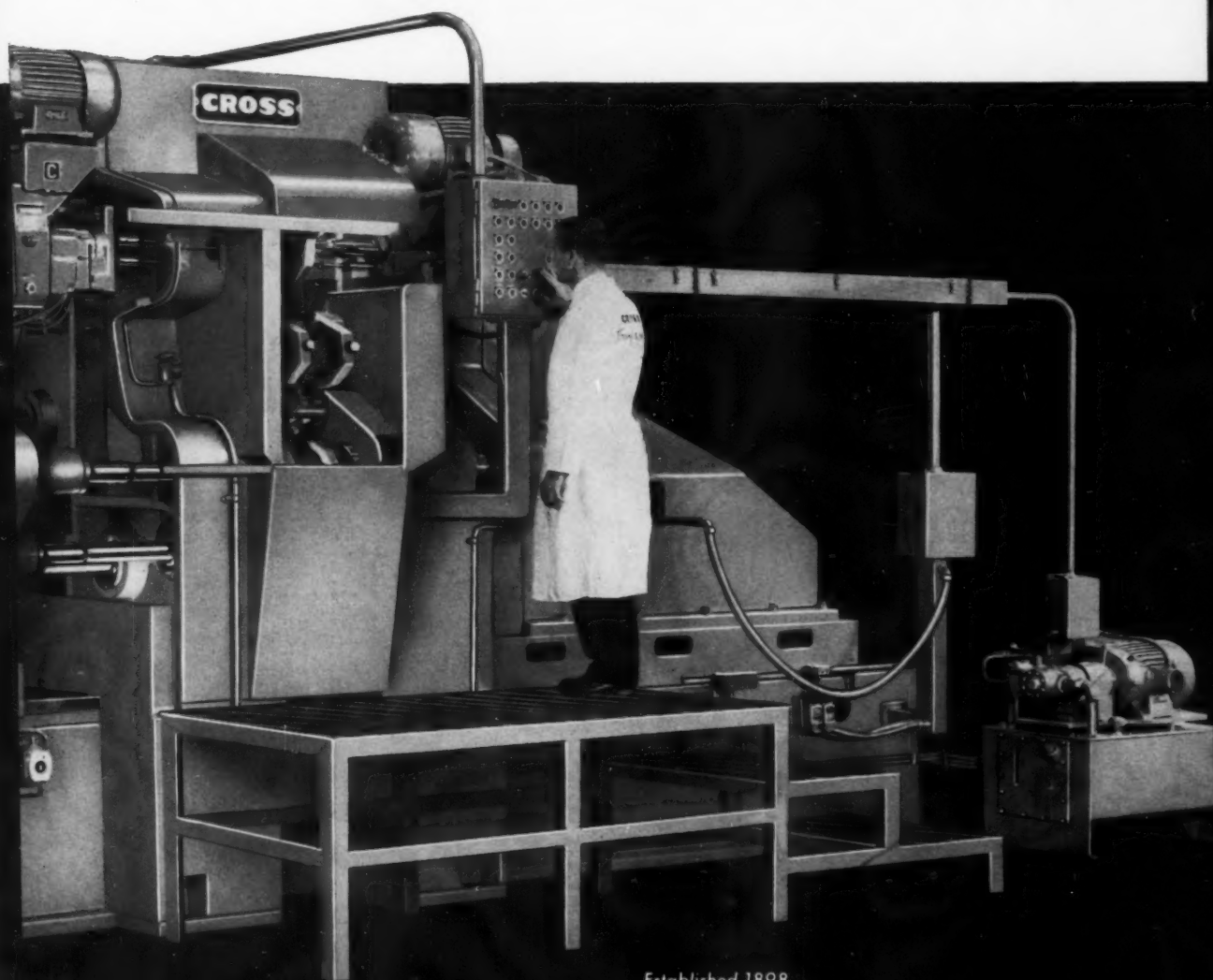
Similar operations such as rough, semi-finish

and finish boring; drilling; counterboring and chamfering are completed by spindles in the two main heads. Dissimilar work such as tapping, facing and grooving are done by four auxiliary heads.

Extremely close tolerances are maintained through single clamping of the part, precision indexing of the trunnion and boring bars which are accurately guided in the trunnion supports.

Future part design changes can be accommodated easily because of the extreme flexibility of the machine.

A Cross Sales Engineer will be glad to tell you more about this new trunnion machine design.



Established 1898

THE **CROSS** CO.
First in Automation
PARK GROVE STATION • DETROIT 5, MICHIGAN

A black and white close-up portrait of a man with a skeptical expression, resting his chin on his hand. The man has dark, wavy hair and is looking slightly to the side with a questioning or doubtful look. His hand is visible at the bottom, with his fingers supporting his chin. The background is plain white.

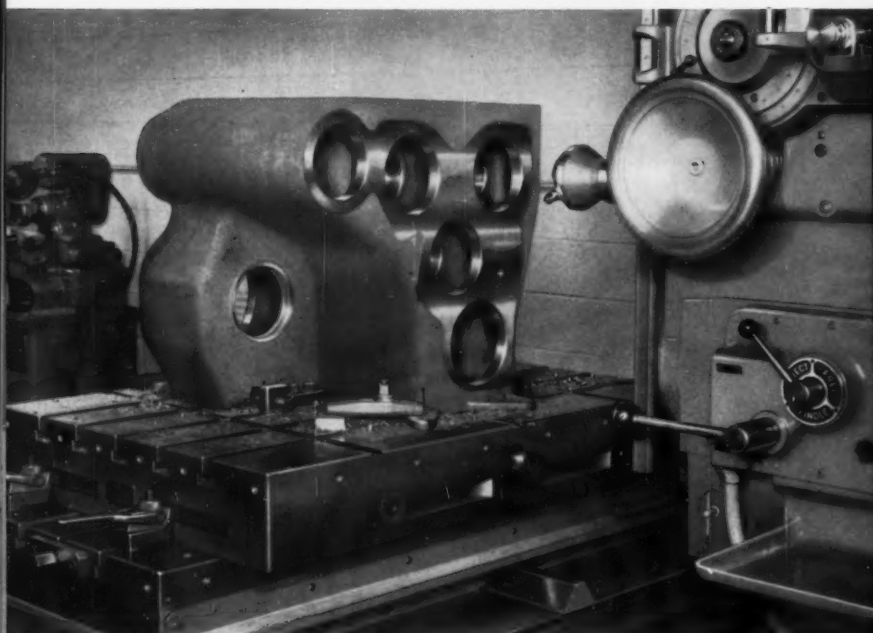
WE
LOVE
SKEPTICS
AT
FAIR
STREET...

DE Vlieg MACHINE COMPANY

Of course, everyone who comes to Fair Street for the first time is a skeptic. At least partially so. But we especially like a good healthy skeptic; the man who finds it hard to swallow all he's heard about the proficiency of our JIGMIL and the soundness of the DeVlieg Philosophy of Precision Machining.

SOME OF OUR JIGMIL USERS

AFC Industries, Inc.
Air Reduction Co., Inc.
Alliance Tool & Machine Co.
Amco Incorporated
Bendix Corp.
Besly Welles Corp.
Bethlehem Steel Co.
Burg Tool Mfg. Co.
Buhr Machine Tool Co.
Cessna Aircraft Co.
Cross Company
Farrel-Birmingham Co., Inc.
Gardner-Denver Co.
Gardner Machine Company
Goulds Pumps, Inc.
Harnischfeger Corp.
Hill Machinery Co.
Homogenette Inc.
Hoover Tool & Die Co.



DeVlieg Spiramatic JIGMIL precision bores and mills mining machine transmission housing from two sides on a 180° index.

The JIGMIL is one of those things that you've got to see demonstrated to believe. Only by seeing it demonstrated will you know its complete range of capabilities. The accuracies that it routinely achieves. The ease with which it operates. How simple it is to program or control. How easy to maintain. How rugged and durable it is. If you're a good healthy skeptic, why not visit Fair Street! As we've just said, we'd love to have you. After all, some of our biggest skeptics have become our best customers.

WILL YOU BE THE NEXT TO VISIT FAIR STREET



FAIR STREET • ROYAL OAK, MICHIGAN

Basic Principles in the DeVlieg Philosophy of Precision Machining

- A Machine Tool Capable of Desired Accuracies
- Correct Tool Geometry
- A Method of Tool Preparation and Maintenance

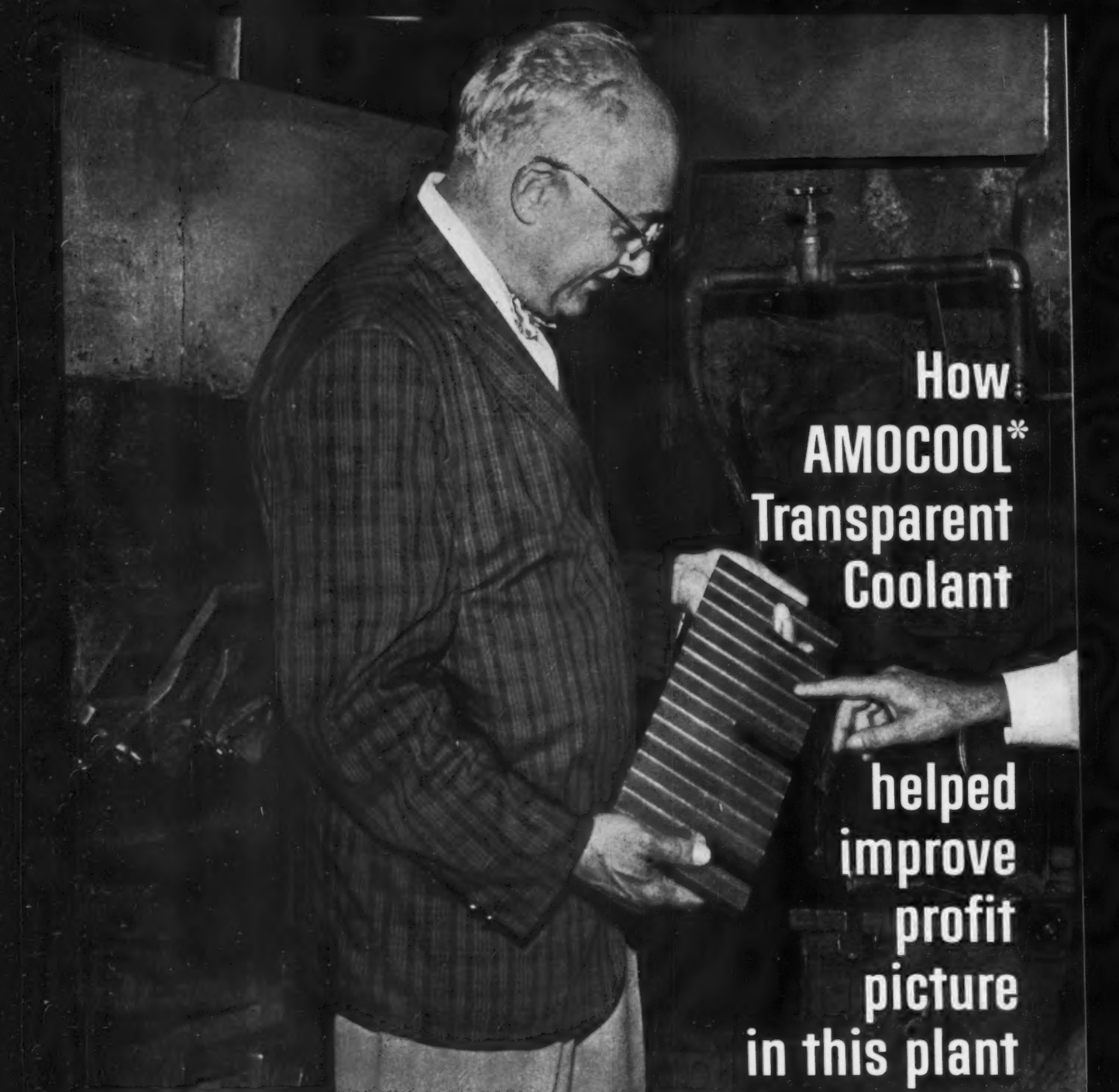
*Only DeVlieg Delivers the Complete
Package!*

Hyster Co.
Ideal Tool & Mfg. Co.
Lake Erie Machinery Corp.
Leesona Corp.
Marion Power Shovel Co.
Mason, Shaver & Rhoades Inc.
Midwest Machine & Mfg. Co.
National Electrical Welding Machines Co.
National Mine Service Co.
New Deal Tool & Machine Co.
Paramount Boring & Machine Co.
Paul Machine Tool & Die Works
Quality Tool and Die Co.
R & B Tool Company
Rochester Products Div., GMC
Saginaw Steering Gear Div., GMC
Snyder Corp.
Standard Tool Co.
Vard Div., Royal Industries Inc.
Vogt, Henry Machine Co.

DeVlieg

SPIRAMATIC JIGMILS®

ACCURATE HOLES AND FLAT SURFACES
IN PRECISE LOCATIONS



How **AMOCOOL*** Transparent Coolant

helped
improve
profit
picture
in this plant

*Trademark



BY PAUL E. "PAPPY" STRATTON

About the Author. "Pappy" Stratton has been providing technical help on lubrication and metalworking problems to customers in the Detroit area for nearly all of the twenty-five years he has been working for the company. In addition to having this store of practical experience to help him, Pappy has completed the Company's Sales Engineering School.

* * *

By using a soap-base grinding compound, Detroit Edge Tool Company was getting excessive corrosion and rust on work and grinding machines. Oil vapor was collecting on machines and on the ceiling, causing dirty working conditions. Most important, high wheel loading was causing frequent down-time for wheel dressings.

We worked out a test program on AMOCOOL Transparent Coolant with the management. On our first test on one surface grinder, feed pressure was cut substantially while at the same time metal removal was increased.



This is
AMERICAN OIL COMPANY
in action

Eliminate reworking because of rust, reduce wheel loading and extend intervals between wheel dressings; do these and you increase profit per unit, explains Detroit Edge Tool president, Dan Ebbing, to P. E. "Pappy" Stratton of American Oil. Plant manager, John Yonker (right) and Sam Vineh, operator, look on.

The cost of reworking parts to remove rust was eliminated. Time required to clean machines to get rid of the odor was cut in half. Less wheel loading and fewer wheel dressings have upped production and reduced costs. Our test program paid out in an improved profit picture. All grinding and drilling equipment has been converted to AMOCOOL Transparent Coolant.

Would you like this kind of technical help to assist you in improving profits? Get it by calling the American Oil Company office nearest you.

Quick facts about

AMOCOOL Transparent Coolant

- Clear, transparent fluid
- Controls corrosion on work and machines
- All chemical. Does not support bacteria growth
- Unaffected by humidity
- Fire resistant.
- Odorless



**AMERICAN OIL
COMPANY**

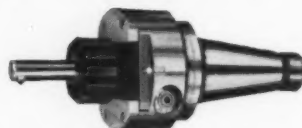
910 South Michigan Avenue
Chicago 80, Illinois

UNIVERSAL
KWIK-SWITCH
TOOL HOLDER
permits
tool changes
in ten seconds!



UNIVERSAL CHUCKS

for every purpose



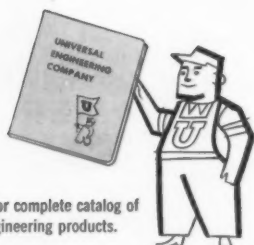
BORING CHUCK



STANDARD COLLET CHUCKS



FLOATING COLLET CHUCK

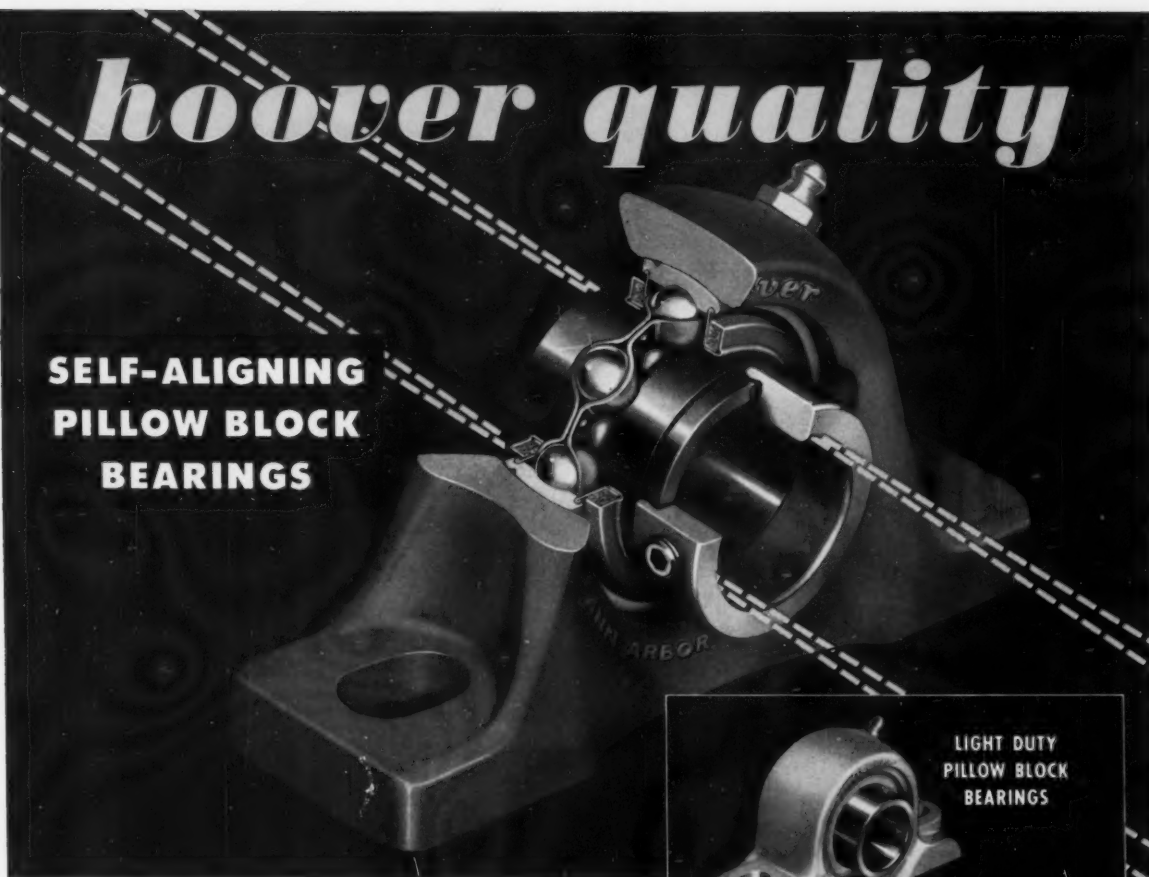


Write today for complete catalog of
Universal Engineering products.

UNIVERSAL ENGINEERING COMPANY • FRANKENMUTH 2, MICHIGAN

hoover quality

SELF-ALIGNING PILLOW BLOCK BEARINGS



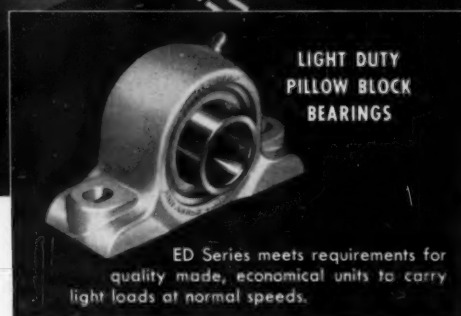
WITH *hoover-honed* RACEWAYS... *micro-velvet* BALLS

Hoover SP and SPH series pillow block bearings are designed for quick, easy installation. They are automatically self-aligning in any direction. The eccentric collar forms a self-tightening shaft lock. Elongated bolt holes in the base of the pillow block simplify mounting.

Hoover Quality bearing features assure long life and superior performance. *Hoover-Honed* raceways are super smooth, superbly finished. *Micro-Velvet* balls are accurate within millionths of an inch. Felt seals with metal shields retain factory applied lube and protect working surfaces from dirt.

Recommended for normal duty load conditions and shock, Hoover SP and SPH series pillow block bearings are available in shaft sizes from $\frac{3}{4}$ " to $2\frac{15}{16}$ ".

Hoover-Honed and *Micro-Velvet* are Hoover Trademarks



ED Series meets requirements for quality made, economical units to carry light loads at normal speeds.

HOOVER PRODUCES A COMPLETE LINE OF BALL AND ROLLER BEARINGS IN TYPES AND SIZES FOR MOST APPLICATIONS



Deep Groove



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Super Max



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Cylindrical Roller

Hoover

BALL AND BEARING COMPANY

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Offices and | 290 Lodi Street, Hackensack, New Jersey
Warehouses | 2020 South Figueroa, Los Angeles 7, California

Hoover Ball and Bearing Company
5400 South State Road, Ann Arbor, Michigan

M-7

Please send Bulletin 106 which describes Pillow Block Bearings.

Name _____

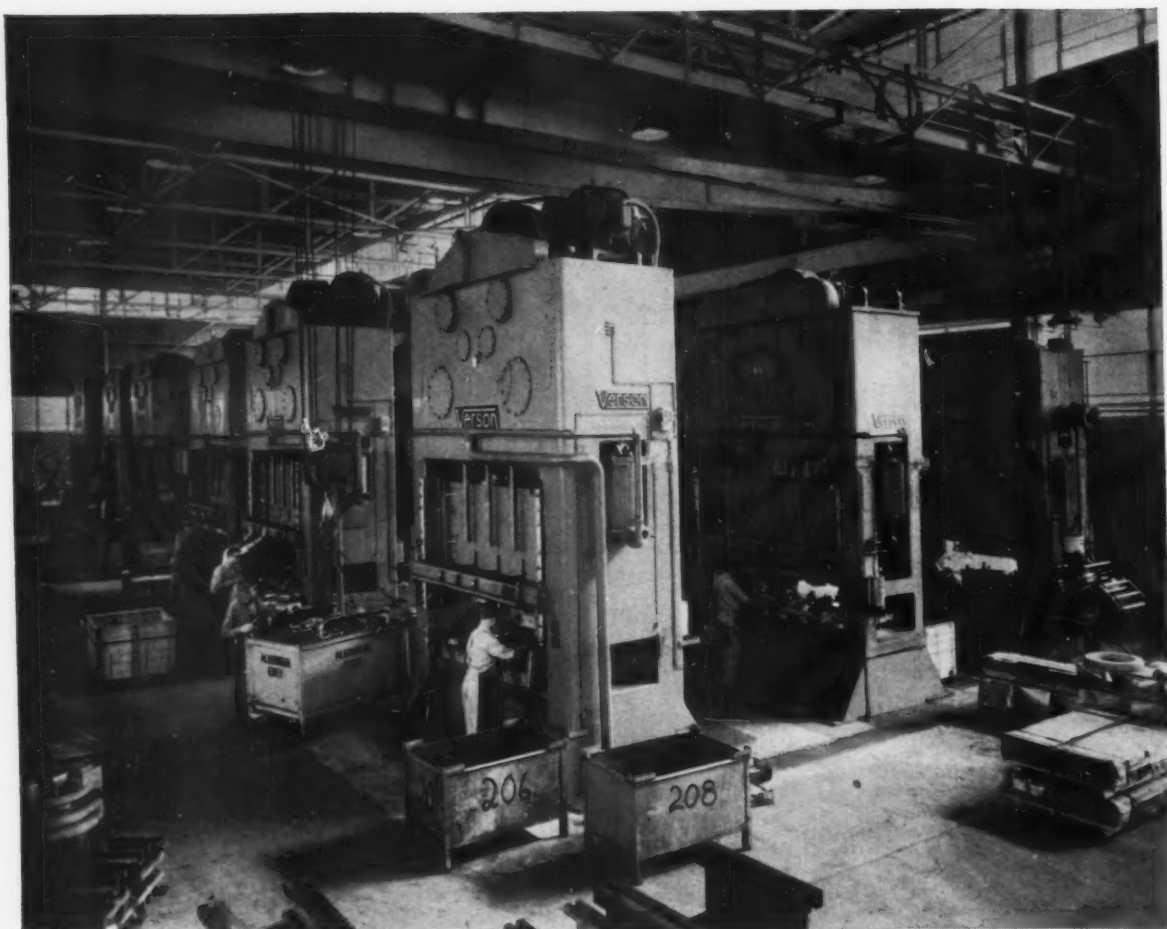
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Company _____

Address _____

City _____

Zone _____ State _____



You can combine flexibility with efficiency with properly selected **Verson** Presses

In this era of the special machine we tend to overlook the economies of machine versatility. Lobdell-Emery Manufacturing Company, Alma, Michigan, a portion of whose press room is shown above, must combine production flexibility with manufacturing efficiency in the highly competitive automotive parts market.

Lobdell-Emery accomplish their objectives with an impressive line-up of rugged, versatile Verson mechanical presses and press brakes, selected for the economical production of such diverse items as hub caps, seat frames and station wagon panels.

Your Verson Representative will be pleased to go over your requirements with you, and show how Verson equipment can give the flexibility you need at costs that will help keep you competitive.



Catalog G-60 describes representative models of Verson's entire line of mechanical and hydraulic presses and press brakes. Write for your copy, today.

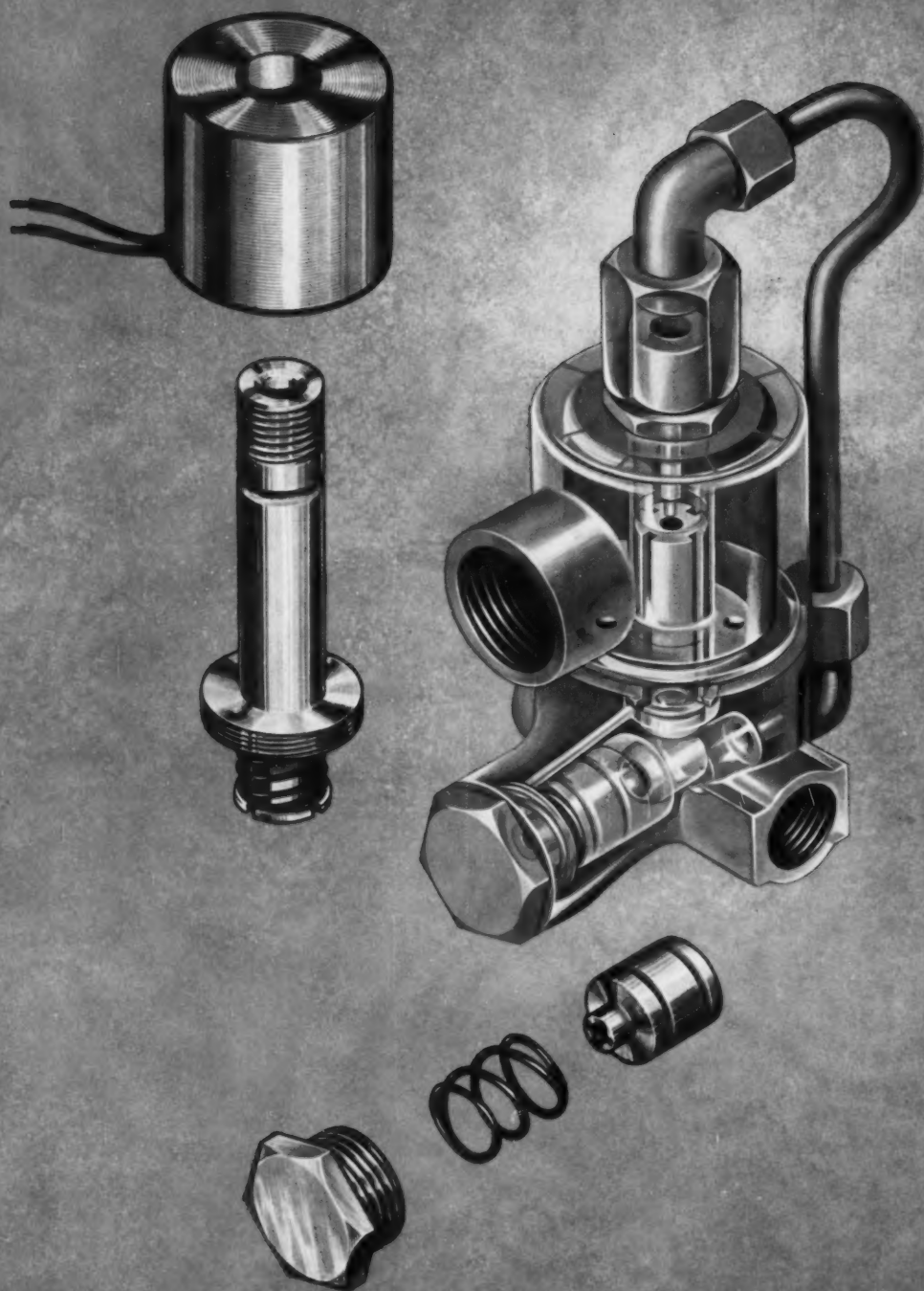


Originators and pioneers of allsteel stamping press construction

VERSON ALLSTEEL PRESS CO.

9309 S. Kenwood Avenue, Chicago 19, Illinois • 8300 S. Central Expressway, Dallas, Texas

MANUFACTURERS OF MECHANICAL AND HYDRAULIC PRESSES AND PRESS BRAKES • TRANSMAT PRESSES • IMPACT MACHINING PRESSES
TOOLING • DIE CUSHIONS • Verson-WHEELON HYDRAULIC PRESSES • HYDRAULIC SHEARS • PLASTICS MOLDING PRESSES

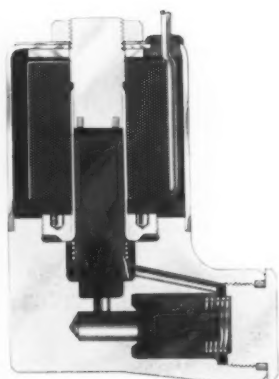
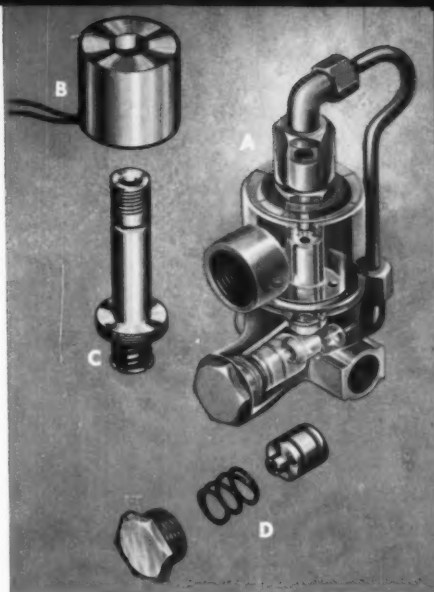


SKINNER 2-way Solenoid Valves
for high flow, high pressure applications

Here's how Skinner two-way valve design provides long lasting, trouble-free operation

- Underwriters' Laboratories approved
- Stainless steel internal parts resist corrosion
- Forged naval brass body
- Famous Skinner V5 solenoid operator
- Well rounded main orifice and pilot seats

A—Transparent view of normally open 2-way R type valve with piped pilot exhaust return
 B—Coil C—Sleeve, plunger and spring assembly
 D—Piston assembly with soft synthetic insert



NORMALLY CLOSED TYPE R2

When you have high-flow control problems at standard or high pressures the new Skinner two-way R series valves may be the answer. These pilot-operated solenoid valves are designed for use with air, oil, water, inert gases and other common media at operating pressure differentials of 5 up to 1250 PSI. They may be used for all types of control applications, such as: in high-pressure lifting, commercial laundry equipment, machinery, machine tooling, spraying, etc.

Skinner R series two-way valves have forged naval brass bodies to provide a dense metal structure and use a foolproof stainless steel piston with soft synthetic insert to open and seal the main orifice. Types are available normally open or normally closed,

in standard and explosion-proof construction.

To make installation easy for every application, a wide choice of electrical housing options is available. These include JIC, AN connector, automotive terminals, etc. All housings can be rotated 360°. Manual override is also offered to permit manual opening of normally closed valves, or closing of normally open valves, in emergency.

Skinner R series valves may be used with all common voltages and frequencies and there are several coil types such as: varnished, molded waterproof, tropicalized and high temperature for specific applications.

The R series, illustrated here, is just one in a complete range of 2-, 3- and 4-way Skinner solenoid valves.

TWO-WAY R SERIES SPECIFICATIONS

Types	R2 XR2	R2H XR2H	R2H6	RP1 XRP1
Position	Normally closed	Normally closed	Normally closed	Normally open
Pipe Size (NPTF Dry Seal)	1/4"	1/4"	1/4"	1/4"
Orifice Size	1/4"	1/4"	1/4"	1/4"
Cv Factor	.758	.758	.758	.758
Operating Pressure Differential (PSI)				
Minimum	5	5	5	5
Maximum AC Service	200	1250	—	150
Maximum DC Service	200	500	1000	150
Leakage	Bubbletight	Bubbletight	Bubbletight	Bubbletight
Temperature Range (Ambient and Media)	Minus 40°F to plus 180°F	Minus 40°F to plus 180°F	Minus 40°F to plus 180°F	Minus 40°F to plus 180°F

When you specify solenoid valves, specify Skinner.

Skinner solenoid valves are distributed nationally.

For complete information, contact a Skinner Distributor listed in the Yellow Pages or write us at the address below.



SKINNER ELECTRIC VALVES

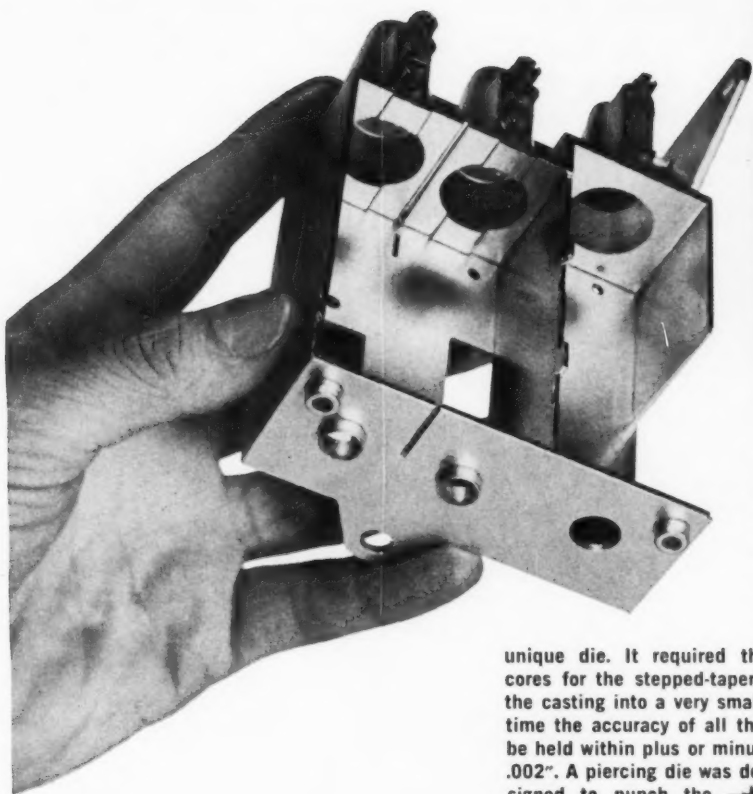
SKINNER ELECTRIC VALVE DIVISION

THE CREST OF QUALITY SKINNER PRECISION INDUSTRIES, INC. • NEW BRITAIN, CONNECTICUT, U.S.A.

PRINTED IN U.S.A.

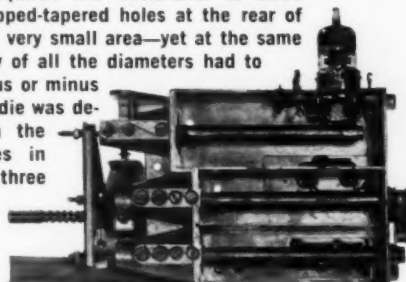
HOW ELSE

WOULD YOU MAKE IT?



■ Supplying this Motorola television tuner housing on a volume basis could have been a real production headache—were it not for the crackerjack combination of a die caster's skill and Zamak. With the performance virtues of these remarkable zinc die casting alloys in mind, Serv-All Tool and Die Company carefully worked up a

unique die. It required the withdrawal of three cores for the stepped-tapered holes at the rear of the casting into a very small area—yet at the same time the accuracy of all the diameters had to be held within plus or minus .002". A piercing die was designed to punch the quarter-inch holes in the housing's three



MOTOROLA TELEVISION TUNER HOUSING

AWARD OF MERIT

The New Jersey Zinc Company's "Zinc Die Casting of The Year" Competition

"ears" as well as several undercuts impossible to cast. These holes were also held to plus or minus .002". ■ Serv-All knew Zamak could give them the castability they needed, could meet the demanding tolerances, could provide the high-strength, thin-wall sections required, and had the ductility for an accurate, easy piercing operation after casting. They also knew of the overall production economies inherent to Zamak—low die cost, long die life and high production speeds. One other characteristic of Zamak sealed the choice—the wide variety of finishing procedures which can be used. In this case the housing is copper-plated to facilitate soldering.

■ Zamak gives you more for less. How else would you make it?

HORSE HEAD® SPECIAL ZINC AND HORSE HEAD ZAMAK ARE PRODUCED BY

THE NEW JERSEY
ZINC COMPANY

160 FRONT STREET • NEW YORK 36, N. Y.
DEVELOPERS OF THE ONLY STANDARD ZINC DIE CASTING ALLOYS IN USE TODAY

HORSE HEAD
PRODUCTS

ARMSTRONG

TOOL HOLDERS

A Correct Tool for Every Lathe Operation

You can save time (and money) by ensuring that your machine tools are equipped with *adequate numbers* of the correct ARMSTRONG Tool Holders. The ARMSTRONG System of Tool Holders includes correctly designed tools for *every* standard operation on lathes, shapers, and planers, and for many operations on turret lathes and screw machines. By utilizing the ARMSTRONG System of Tool Holders, you can reduce tooling costs, eliminate down time in tooling up, operate your machine tools at maximum feeds and speeds.

ARMSTRONG Tool Holders are long-lasting tools. They are strong beyond need, handy and efficient, profitable to use, and are readily available from your local ARMSTRONG Distributor.

Check over your ARMSTRONG Tool Holder needs.
Write for literature.



If you do not know the name
of your local ARMSTRONG
Distributor, inquire when
asking for literature.

ARMSTRONG BROS. TOOL CO. 5213 W. ARMSTRONG AVE. CHICAGO 46, ILL.

Here is why your next O.B.I. should be a Clearing

Vastly Improved Clutch and Brake Unit

An oil-immersed clutch and brake that's "built to be forgotten". This improved air-friction clutch and brake unit never requires adjustment. Wear is so negligible as to be virtually non-existent.

"Clearelease" Unsticking Mechanism

In the event of a jam where the press slide is stuck on bottom, "Clearelease" makes it possible to release the jam, be back in operation in minutes.

All Steel, Enclosed Design

Clean, space-saving design improves safety. Flywheel and moving parts are completely enclosed. Rigid all steel frame resists deflection, prolongs working life of expensive dies.

Micrometer Precise Slide Adjustment

A fine adjustment setting for unusually accurate slide positioning has been newly designed. Adjustment also contains a lock which holds the slide rigidly at the desired setting.

Complete Electrical Controls... Shock Mounted

Your Clearing O.B.I. will have operator's control buttons and master control panel, wired-in and in place when shipped. Five position selector switch is key-locked.

Get the Facts on the many carefully engineered features of Clearing's line of O.B.I. presses—22, 32, 45 and 60 tons capacity.



usi Clearing

DIVISION OF U. S. INDUSTRIES, INC.
6499 W. 68th Street • Chicago 38, Illinois



HUMAN EAR

No longer needed

to

SOUND-TEST GEARS



The inspector's hearing and his judgement have not always been dependable in discriminating between gear noise which may be tolerated and that which may not. In fact, these human qualities are not consistent even in the same individual at all times.

To avoid such inconsistencies, the Red Ring Sound Tester may now be equipped with an electronic broad-band amplifier. Sound intensity is measured and the result indicated on a graduated visual scale. Thus, it is simple to establish sound tolerance limits independent of the human equation and maintain uniform quality.



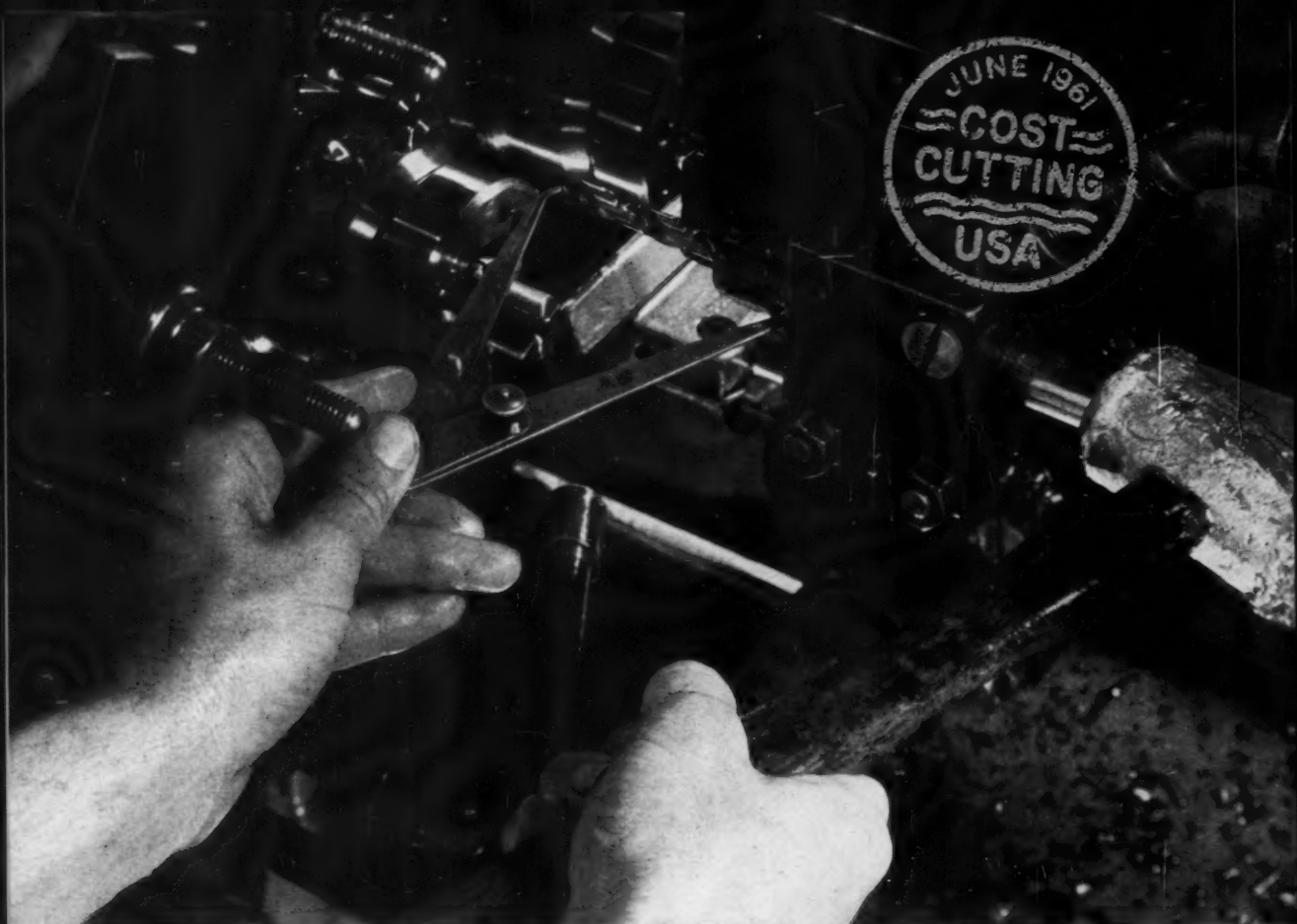
SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING,
GEAR HONING AND ELLIPTICAL

For further information write for Bulletin C 60-8

NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING AND HONING EQUIPMENT



\$50,000 GAGE! (*what does it cost in reduced net income?*)

Using \$50,000 machines as toolsetting gages is throwing away money. And there's an easy way to stop it. One plant increased net income per machine by \$70 a day—another increased total annual net by \$250,000. They equipped their machines with Quick-Change preset toolholders. Tools and holders are accurately set in low-cost gages while the machine is running. Less than 30 seconds is required to insert a drill, and it's ready to produce accurate parts on the first cut. There's no cut-and-try scrap. Savings don't stop there: Presetting reduces setup time. And with reduced tool cost, you can step up cutting speeds—initial price of tools is peanuts compared with direct labor and machine-hour charges. / Net return is not built around cycle time or cost per piece, but on total cost, including setup, downtime, and regrinding to size. Further, if you can maintain tool size, certainly you can maintain higher quality. Scully-Jones offers Quick-Change, preset tooling for almost every type of machine tool. Ask for a tooling study and cost estimate on **QUICK-CHANGE, QUICK-SET TOOLING**.



Scully-Jones and Company

1906 South Rockwell Street, Chicago 8, Illinois



Something **NEW...**
designed for your convenience

TIME DELAY
Limit Switch
Bulletin 802T



TIME DELAY
Push Button
Bulletin 800T



Adjustable From 1 to 15 Seconds

This new Allen-Bradley development should solve such occasional problems where, upon the operation of the push button or limit switch, a slight time delay should occur. Time delay is adjustable up to 15 seconds—and it can also be introduced when "stopping" the operation—but not in both the "starting" and "stopping" cycle.

Both push-button and limit switch are relatively low in cost—ideal for applications where a delay of only a few seconds is desired, and where the repeti-

tive accuracy of the Allen-Bradley Bulletin 849 time delay relay is not necessary. Both units have single pole, double break contacts—either normally open or normally closed. They are no more difficult to install than the corresponding units without the time delay feature.

Machine tool and production system designers should have full information in their files on these new Allen-Bradley time delay push buttons and limit switches. It is yours for the asking. Write today.

ALLEN-BRADLEY

Member of NEMA

Allen-Bradley Co., 1331 S. First St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

QUALITY
MOTOR
CONTROL



POSITIVE DUPLICATION—EVERY TIME!



These "fingerprints" of a tree will always duplicate characteristics by which an expert can positively identify all cross-sections from the trunk of that tree. But you don't have to be an expert to get Positive Duplication—when you use these CINCINNATI® SEGMENTS, and *all* CINCINNATI GRINDING WHEELS.

YOU GET (PD) UNIFORMITY

Cincinnati supplies you with wheels of uniform excellence, because of the unique ® manufacturing process which involves 36 separate and unvarying quality controls.

Every step, from grain mix to final inspection, is directed to uniformity of product. For example, while vitrified wheels are being fired, automatic recording analyzers keep sampling the kiln atmosphere to maintain desired oxygen content throughout the firing process.

RESULT: DEPENDABLE PERFORMANCE

You can *depend* on ® WHEELS because each reorder

wheel gives you exactly the same good job as the original.

Using ® WHEELS you will find production going up, and costs going down . . . *to stay!* This is the promise—and the performance—of Positive Duplication.

CALL CINCINNATI TODAY

Solve your grinding problems with the help of specialists trained by the Cincinnati Milling Machine Company. Their wide experience in job set-ups and grinding operations is at your service.

Just call your CINCINNATI® GRINDING WHEELS Distributor or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.



POSITIVE DUPLICATION

CINCINNATI®
GRINDING WHEELS

®Trade Mark Reg. U.S. Pat. Off.

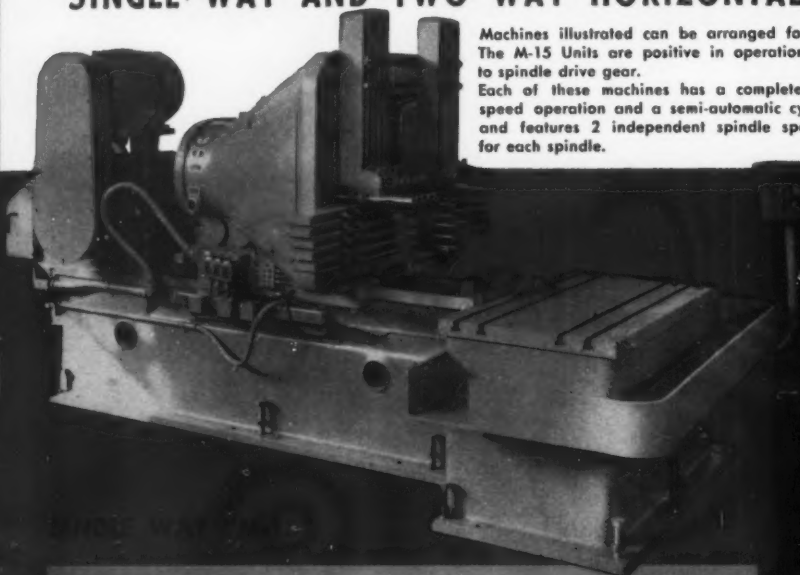
MACHINERY, July, 1961

A PRODUCTION-PROVED PRODUCT OF THE CINCINNATI MILLING MACHINE CO.

For more data, circle this page number on Readers' Service Card.

41

BAUSH MECHANICAL LEADSCREW FEED "M-15" SINGLE-WAY AND TWO-WAY HORIZONTAL MACHINES



Machines illustrated can be arranged for both drilling and tapping. The M-15 Units are positive in operation as feed is geared directly to spindle drive gear.

Each of these machines has a completely automatic cycle for high-speed operation and a semi-automatic cycle for low-speed production and features 2 independent spindle speeds plus a neutral position for each spindle.

MECHANICAL LEADSCREW FEED

is an exclusive with BAUSH.

Many commendable reports have been received from users as to their numerous advantages:

No hydraulic fluid.

No fluid leaks or fluctuation in feed.

Indirect maintenance costs reduced.

Your own mechanic can maintain unit.

Positive feed thru ball-screw.

Break-thru surge eliminated.

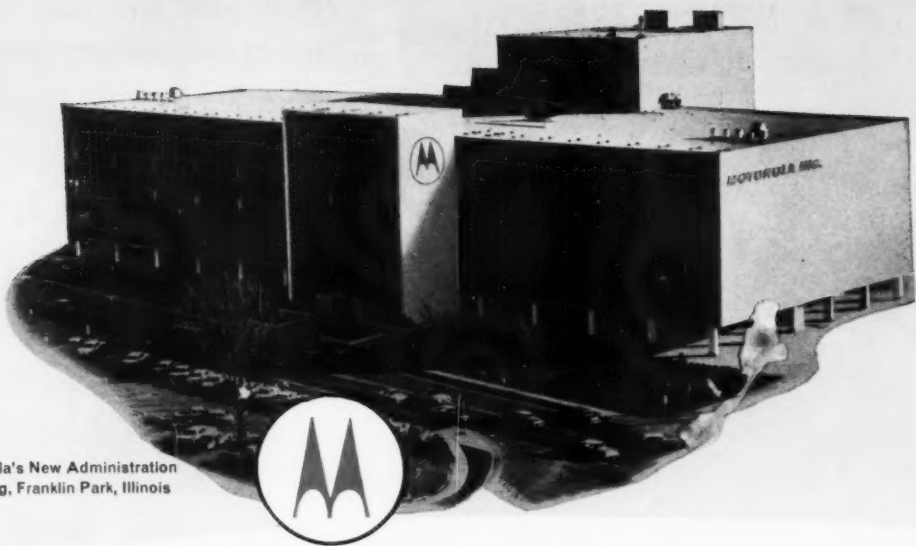
Drill breakage and part spoilage reduced to minimum.

The "M-15" Units used on both these machines are extremely versatile — positive in action — trouble free — fast operating and can be mounted vertically, horizontally, or at any angle needed for specific machine designs. These Units are also available in 10 H.P. to 40 H.P. capacity to meet requirements.

When head goes from rapid traverse to feed stroke, an electric brake holds leadscrew and shuts off traverse motor — saving wear and tear. "M-15" Units are the answer to high production at lowest cost.



B
BAUSH
MACHINE TOOL CO.
SPRINGFIELD 7, MASSACHUSETTS



Motorola's New Administration
Building, Franklin Park, Illinois

Motorola's philosophy of re-equipment policy explained in its advanced mechanization manual

Emphasis placed on importance of well-organized
procedure for replacement of capital equipment

On this page in January, 1960, it was stated that Motorola Inc., Chicago electronic manufacturer, had given much study to the matter of equipment replacement and had chosen to use a modification of the MAPI Formula in determining the economic advantage of replacing equipment in use with new and improved models.

It was also stated that Motorola had chosen to evaluate the expenditure for all new equipment by using a re-equipment analysis and operation comparison form. It was felt that one great advantage of this is that it forces the individual to complete the thought process with an unbiased and complete review of the effects upon return on investment, reliability, and anticipated engineering advances.

In order to enlighten all who are involved in the matter of equipment replacement, Motorola gives detailed information concerning items that affect re-equipment studies in its Mechanization Manual.* These are preceded by the following statement under the heading, PHILOSOPHY OF MOTOROLA'S RE-EQUIPMENT POLICY:

"The Re-Equipment Analysis and Operational Comparison form was designed specifically for the purpose of helping Management decide a course of

action from two or more courses of action regarding replacement of equipment. It is a tool which will tell you, for example, whether it is more economical to hand assemble a given product, or to use a more highly mechanized piece of equipment for the job.

"This form is not directly applicable to Make or Buy studies since an analysis of this kind requires consideration of numerous factors which do not concern re-equipment studies.

"The Re-Equipment Analysis and Operational Comparison form was so designed that all facts pertaining to the present and proposed methods are presented in a clear, easy-to-follow manner."

The items that affect re-equipment studies are followed by "some points worth noting" and detailed instructions for completing the Re-Equipment Analysis and Operational Comparison Form.*

Since space will not permit going into the points and instructions, it will suffice to point out that Motorola, like many other leading companies, is placing increased emphasis on the importance of well-organized procedure in the replacement of capital equipment.

*Available only for use within the Motorola organization.

*Keep gathering metal-working production ideas . . .
be well informed when you replace machinery.*

} ROCKFORD INSERT GROUP



TOTAL JOB ANALYSIS multiplies savings over ordinary cost studies.

Your company can profit from this dual approach to cost reduction. At the Lockformer Co., Chicago manufacturer of roll forming machinery, hourly out-

365%

put of forming rolls (upper right) was increased from 8.6 to 40. A round figure gain of 365%! Other jobs (most of them short runs) showed similar gains. // First, Lockformer's hobs were redesigned to increase machine speed. The roll gear, for example, originally cut with a $2\frac{3}{4}$ " single-thread hob at 204 rpm, now is cut with a triple-thread, $3\frac{1}{4}$ " diam hob at 306 rpm. Feed is the same, but cutting time has been reduced. Second,



July, 1961

For more data circle No. 831 on card at back of book.

CENTER OF MACHINE-TOOL EXCELLENCE

ROCKFORD, ILLINOIS, U.S.A.

cycle time was trimmed by a Barber-Colman No. 16-16 MULTI-CYCLE machine. Combination power vertical feed and automatic cycling reduced approach distance. Rapid traverse of the workslide and hob carriage reduced noncutting time. To sum up— an automatic



INCREASE

cycling machine with complete general-purpose flexibility was combined with proper hob design to increase productivity 365%, and with better accuracy, finish, and tool life. // Take advantage of a Barber-Colman total job analysis to reduce your costs. A complete cost evaluation... developed from your gear prints and production requirements and backed by a machine demonstration in our TEST CENTER (right). Phone your Barber-Colman representative for details.



BARBER-COLMAN COMPANY

72 Loomis Street, Rockford, Illinois



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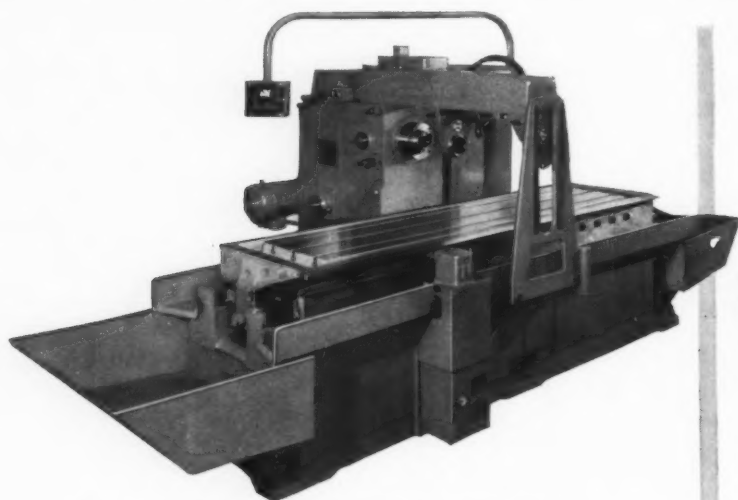
July, 1961

CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**



RIGIDMIL

RIGIDITY...THE KEY TO SUCCESSFUL MILLING



It's easy to put horsepower into a milling machine, but can you deliver this horsepower to the tool without chatter, vibration, or accuracy-destroying deflection? The answer is "yes", with a Sundstrand Rigidmil.

Sundstrand has a reputation for building extremely rigid precision machines — a reputation that is fulfilled to the maximum in its complete line of Rigidmils.

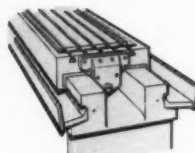
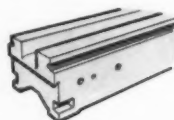
You can use the full horsepower that's built into the machine without any sacrifice in smoothness and accuracy of operation. You can take heavier cuts, run at higher speeds, and use larger diameter cutters. The result is greater production . . . plus longer tool life . . . plus greater accuracy . . . plus better finishes than would be possible with less rigid machines.

When you buy a Sundstrand Rigidmil, you get *more machine* — with the weight where it counts to set completely new standards of milling performance in your plant.

Ask for a Sundstrand "Engineered Production" analysis which evaluates your requirements from the standpoint of production, range and size of parts, types of milling operations, and the economics of the machine and the machining. Based on this study, Sundstrand engineers will recommend the machine that's best for the job — and best means most economical in the long run. Ask for complete information.

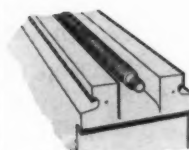
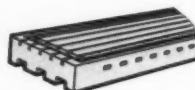
WHAT MAKES A SUNDSTRAND RIGIDMIL RIGID?

Thick-walled, cast iron beds with full partition ribbing.



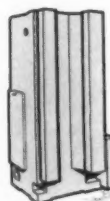
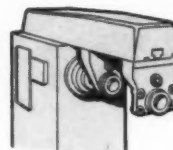
Large box-type ways integral with the bed and widely spaced for full table support.

Extra-thick cast iron tables with rigid drive screw end mountings.



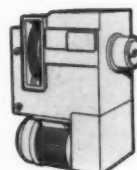
Direct center drive to table through a precision drive screw with double nuts to eliminate backlash. No side thrust against table gibs.

Overarms of strong box-type cast iron construction.



Box-type cast iron column with partition ribbing and widely spaced integral vertical ways.

Heavy cast iron spindle head housing rigidly supports gear shafts — adjustable taper gibs align head rigidly on vertical ways — extra heavy spindle with large-diameter bull gear.



You'll see why Sundstrand Rigidmils do more work more accurately day after day when you study their design features in Bulletin No. 629-1. Ask for your copy today.



SUNDSTRAND MACHINE TOOL

Division of SUNDSTRAND CORPORATION
BELVIDERE, ILLINOIS



July, 1961

For more data circle No. 832 on card at back of book.

CENTER OF MACHINE-TOOL EXCELLENCE

ROCKFORD, ILLINOIS, U.S.A.

STATION 4

Semi-finish bore shaft hole and cover bore. Rough generate cylinder face, recess.

STATION 5

Idle.

STATION 6

Drill and countersink mounting holes. Semi-finish bore pilot hole, rough bore and chamfer bearing cup and seal diameters.

STATION 3

Generate cover face. Rough bore and chamfer for adjuster thread. Rough bore pilot dia.

STATION 2

Rough bore and chamfer cover hole. Rough bore Shaft Hole.

STATION 1

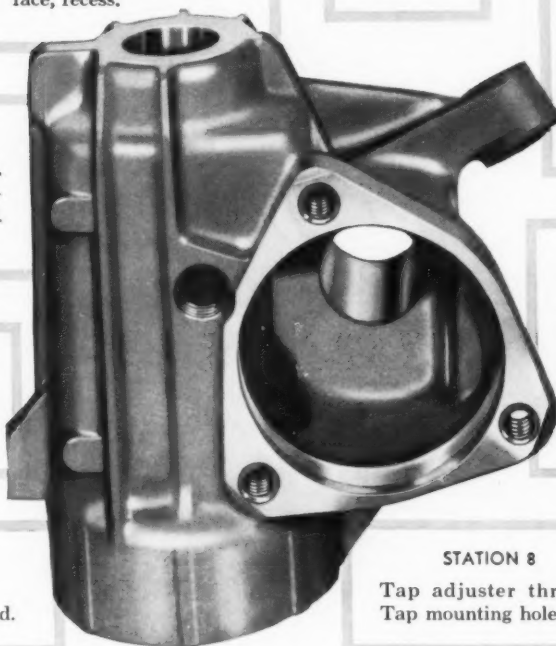
Load and clamp. Unclamp and unload.

STATION 7

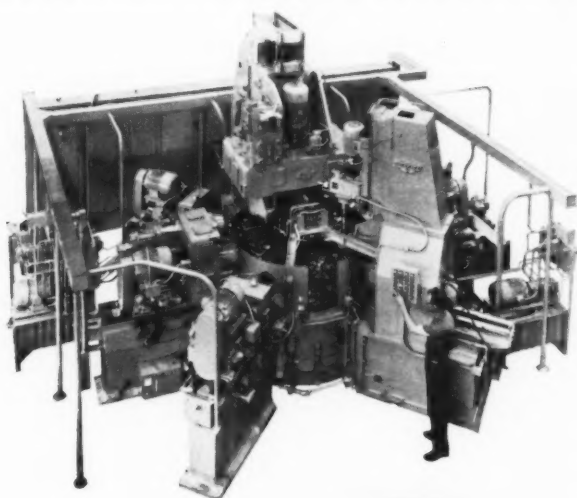
Finish bore cover and shaft holes. Finish bump face side cover. Finish bore adjuster thread, pilot, bearing cup and seal diameters. Bump face cylinder.

STATION 8

Tap adjuster thread. Tap mounting holes.



153 Aluminum Steering Gear Housings per hour automatically processed on this GREENLEE Machine



This Greenlee 8-Station Horizontal and Vertical Spindle Machine is establishing some excellent performance records for a leading automotive manufacturer. The 52 inch table carries 8 work fixtures. Each has power clamping. To insure rigidity and accuracy, the table is clamped hydraulically metal to metal. Indexing is fully automatic. Cycle time is 23.5 seconds. Like all Greenlee machines it's built for long, continuous service. Can be modified economically if desired. Have our representative give you complete information.

MACHINES DESIGNED
WITH THE FUTURE IN MIND



TRANSFER MACHINES • SPECIAL MACHINES • AUTOMATIC BAR MACHINES • WOODWORKING MACHINES AND TOOLS
DIE CASTING MACHINES • TRIM PRESSES • HYDRAULIC AND HAND TOOLS • COMMERCIAL CASTINGS

For more data circle No. 833 on card at back of book.

July, 1961

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**





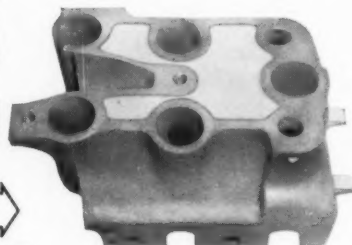
ABRASIVE MACHINING

eliminates hidden costs



IMPROVES ACCURACY and FINISH

COST-PER-PIECE

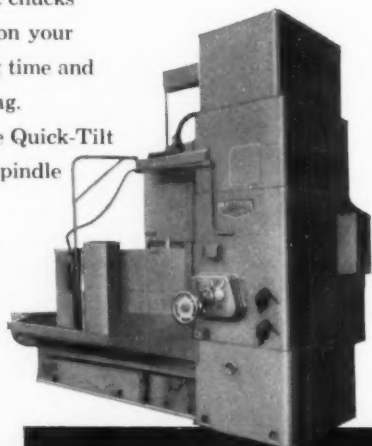


REDUCED \$9.83 ➡

these jobs were switched from milling to
(high-powered) **SURFACE GRINDING**

* * * * *

Abrasive machining of flat pieceparts simplifies the total job — setup, loading, and tooling. Improvements in grinding wheels and high-powered surface grinders change the basic *economics* of flat machining. It is now economical to *remove stock* on a Mattison grinder because of the high average running time and efficient stock removal inherent in today's process. With self-sharpening wheels, the only noncutting machine time is for loading and unloading the work. Simplicity of magnetic chucks minimizes workhandling and holding problems. You get a high net return on your capital investment — and, as hundreds of jobs prove, your actual machining time and wheel cost per piece can be less than their equivalents in big-chip machining. Extent of new developments in machine capability can be illustrated by the Quick-Tilt vertical rotary (shown). This grinder has selector-switch actuated, power spindle tilting. Parts can be roughed with a tilted wheel and finished with a flat wheel in *one* operation. You save horsepower, machining time (50% or more), and grinding wheels. Wheel specifications are less critical, too, extending their usable range. Mattison is putting up to 200 hp on surface grinders — taking 1/4" stock off *large* surfaces in 2 1/2 minutes. With proper application of horsepower and rigid machines, you get *economical wheel life*, plus all the advantages of a "throwaway" cutting tool. Investigate *abrasive machining* for low-cost stock removal and fine finishing of large and small pieceparts. We'll be happy to demonstrate, *on your work*, in the Mattison Methods Lab.



MATTISON MACHINE WORKS

Rockford, Illinois

Phone WO 2-5521



July, 1961

For more data circle No. 834 on card at back of book.

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**



QUALITY...TODAY'S DIFFERENCE BETWEEN PROFIT AND LOSS!

These are the days of the 12-month warranty . . .
extended service guarantees! Never before has Quality been so important.

That's why we suggest you consider Barnesdril Honing Machines
for your surface finishing operations. Because of the quality
inherent in these precision-made machines, they impart that "extra"
touch of quality to your products at cost-cutting production speeds.

Our detailed story — backed by 35 years of specialization in honing —
is yours free! Ask for catalog 200.



*Honing Machines/Production Units
Filtration Units/Drilling Machines*

BARNES DRILL CO.

820 CHESTNUT STREET • ROCKFORD, ILLINOIS
DETROIT OFFICE • 13121 PURITAN AVENUE



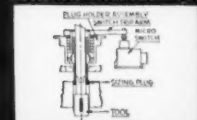
QUALITY is insured with correct
hone feeds . . . made possible
with this easy-to-set infinite
hone feed control.



QUALITY at high-production
rates means exact spindle speed
rates . . . selected with a flick
of the fingers.



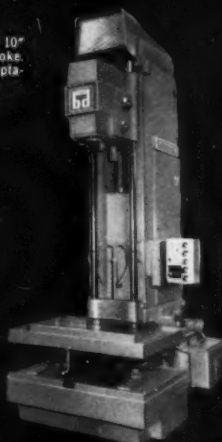
QUALITY results from correct
reciprocation speeds . . . easily
selected with this dial or, on the
Model 122, a calibrated scale.



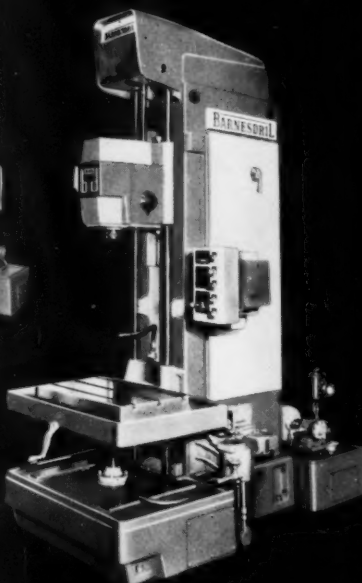
QUALITY is automatic with
Plugmatic bore-to-bore sizing
— production size consistency
maintained to .0002".

Model 3010 hones up to 10"
diameter at full stroke.
Choice of 4 strokes. Adaptable
for full automation.

Model 122 hones bores up
to 2" in diameter at full
stroke. Available in 1 or 2
spindles and a variety of
fixtures and tables.



Model 244 hones bores up
to 4" in diameter at full
stroke. Choice of 3 stroke
lengths, single or multiple
spindles.



OUR FULLY EQUIPPED JOB HONING DEPARTMENT CAN HONE
ANYTHING UP TO 25 FEET IN LENGTH. WRITE FOR DETAILS!

For more data circle No. 835 on card at back of book.

July, 1961

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**



PALLET TYPE

SUNDSTRAND "ENGINEERED PRODUCTION" TRANSFER MACHINES

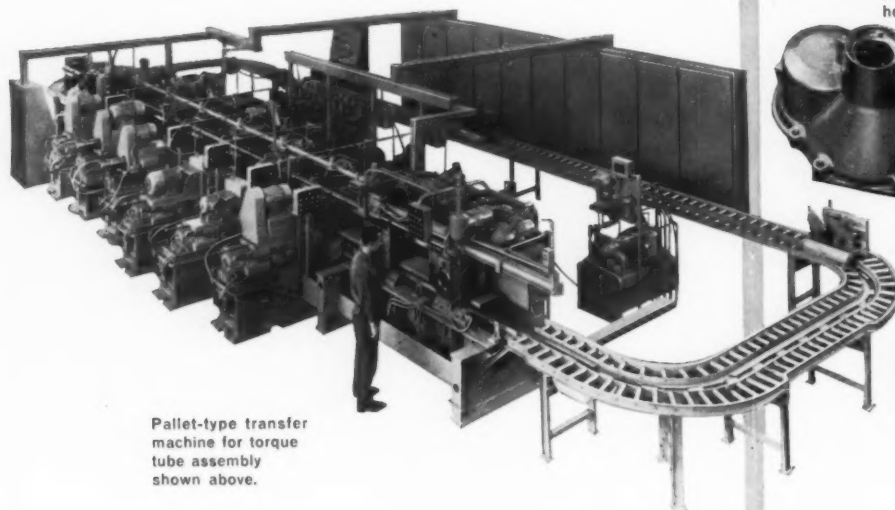
When you require high production of irregularly shaped parts which are difficult to handle and locate — or of parts made of soft metals which might be damaged by consecutive locating operations — Sundstrand pallet-type transfer machines can be your answer.

Parts and their holding fixtures are mounted on pallets which carry them from station to station throughout the machine. They need to be handled, located, and clamped only once for a run through the line. All types of machining operations can be performed. Standard stations and heads are available for drilling, boring, reaming, tapping, milling, and related operations.

The design of the machines provides great flexibility, high accuracies, and minimum nonproductive time. Pallets are located by a unique locating system, completely out of the way of coolant and chips. Workholding fixtures can be designed for quick, easy repositioning to permit machining of different surfaces of the parts simply by running them through the line again. Even limited runs of 500 to 1000 of each of a family of parts can be made economically practical by machines having quickly interchangeable heads.

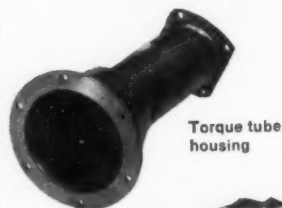
As a result of such design innovations, many jobs once considered impractical for transfer-type machining today are being profitably handled on Sundstrand pallet machines.

Sundstrand offers you nearly a quarter of a century of experience in developing cost-reducing answers to high-production machining. Take advantage of it — ask for a Sundstrand "Engineered Production" analysis of your operations. There is no obligation.



Pallet-type transfer machine for torque tube assembly shown above.

One locating . . . one clamping
... easy handling for high
production of parts like these



Torque tube housing



Clutch housing



Universal joints



Hydraulic motor housings



Transmission rear bearing retainers



Send for Bulletin No. 629-1 describing ingenious solutions to high-volume production with Sundstrand pallet-type, work transfer, and index or dial-type machines. Write today.



SUNDSTRAND MACHINE TOOL

DIVISION OF SUNDSTRAND CORPORATION
BELVIDERE, ILLINOIS

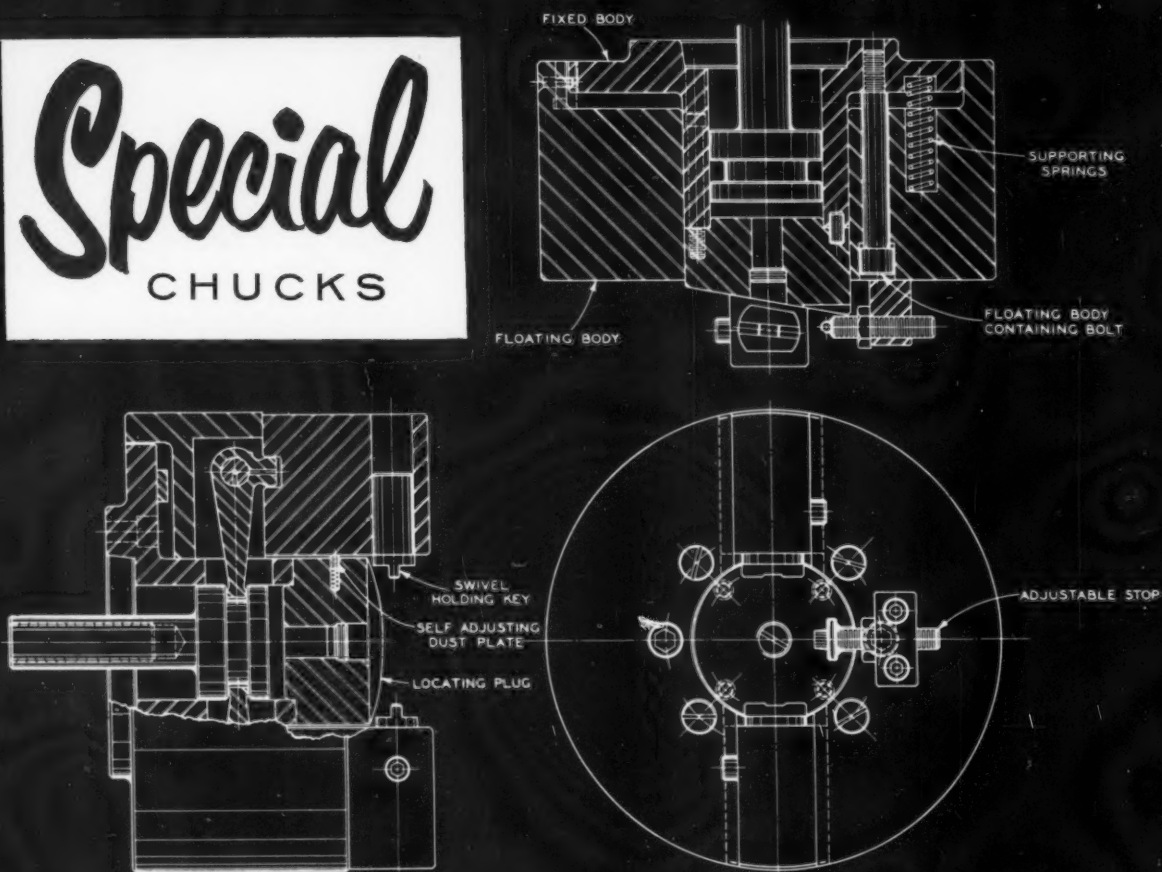


July, 1961

For more data circle No. 836 on card at back of book.

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

Special CHUCKS



The assembly print reproduced above is but one of many examples of special chucks designed and engineered to meet most unusual workholding and machining requirements. Cushman Special Chucks are being used in many diverse industries enabling manufacturers to meet realistic production quotas, maintain close tolerances, and achieve lowest costs on both short or long runs.

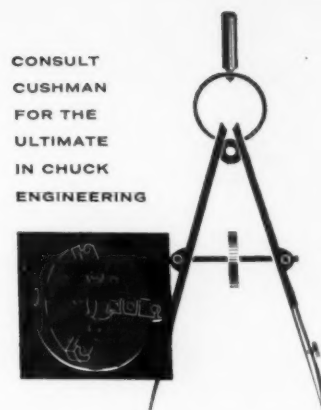
If you have a workholding problem, consult Cushman. Your problem may have already been solved.

THE CUSHMAN CHUCK COMPANY • HARTFORD 2, CONNECTICUT

Manufacturers of Air and Manually Operated Chucks, Power Wrenches, and Face Plate Jaws.

MACHINERY, July, 1961

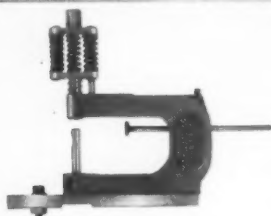
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**CONSULT
CUSHMAN
FOR THE
ULTIMATE
IN CHUCK
ENGINEERING**



**Strippit
Punching Units
help speed
production
of new
B 52 H**



STRIPPIT self-contained units are the most efficient, most economical method of punching holes in metal. That's why Boeing Airplane Company has utilized thousands of them in the production tooling for the latest, most devastating version of the famous Stratofortress.

STRIPPIT Units consist of holders containing the punches, dies, stripping guides and stripping springs. Any good mechanic can quickly set up these units to punch the pattern of holes desired. The "C" Unit shown here, for

instance, is ideal for close center-to-center rivet holes in wing and fuselage sections. This "C" Unit also features a pedestal die for punching holes in angles, channels, shapes and extrusions.

All STRIPPIT Units are independent, self-contained and self-stripping. They provide permanent alignment of punches and dies for precise hole positioning. There are a tremendous variety of STRIPPIT Units, with capacities up to 3.5" hole diameters and $\frac{3}{4}$ " thick material.

Find out how The STRIPPIT System can speed your production and cut your press "down-time" to a minimum. Write now for free catalog.

WALES STRIPPIT INC.

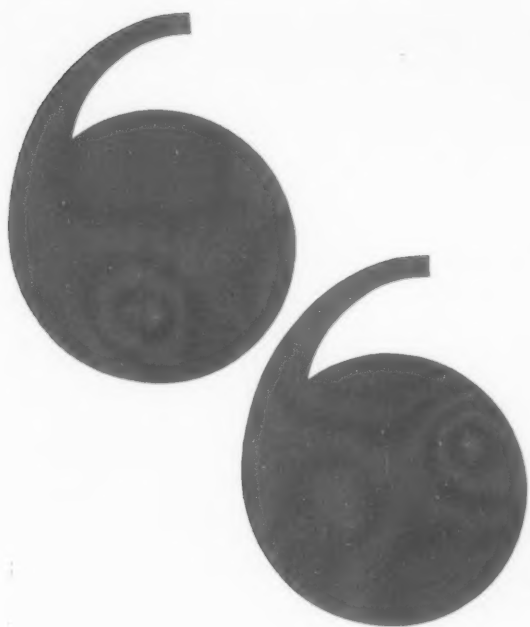
203 Buell Road • Akron, New York

In Canada: Strippit Tool & Machine Company, Brampton, Ontario

In Continental Europe: Raskin, S.A., Lausanne, Switzerland

In the British Isles: E. H. Jones (Machine Tools) Ltd., Hove, Sussex, England





This machine is a technical breakthrough.

This is the essence of precision.

*In my opinion, Centalign® bore grinding
and race grinding equipment is the
finest and most modern single purpose
equipment available anywhere
in the world today.*

*No comparable machine
available from other sources.*



These actual quotations are typical of what people throughout the metalworking industry are saying about Bryant CENTALIGN Internal Grinders. Your nearest Bryant or Ex-Cell-O Sales Representative will be pleased to tell you why.

BRYANT

Chucking Grinder Co.

20 CLINTON STREET, SPRINGFIELD, VERMONT, U. S. A.

Internal Grinders • Special Machinery



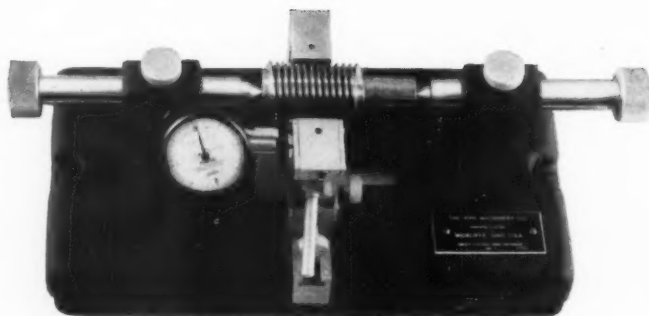
**GAGES GET A
FAST TRIAL
AND FAIR
SENTENCE...**

**with Pipe Machinery's
Drunken Thread Checker**

Easy to set up, easy to operate, Pipe Machinery's amazing new Drunken Thread Checker tries gages for helix deviation, or drunken thread, and passes sentence all in a matter of seconds! The finding it makes — a direct reading of the degree the helix deviates from normal — is final and incontestable.

A diameter over wire check of gages provides insufficient evidence to enable you to render an "acceptable" verdict. In order to be a fair judge in your gage inspection, a check for drunken thread, in addition to a careful examination of, among other things, lead, angles and pitch diameter is always required.

The instrument shown is easily adapted to product inspection with male or female centers.



For more complete information write us on your company letterhead today.



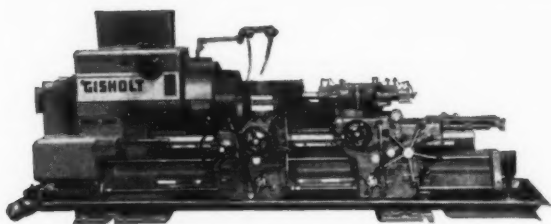
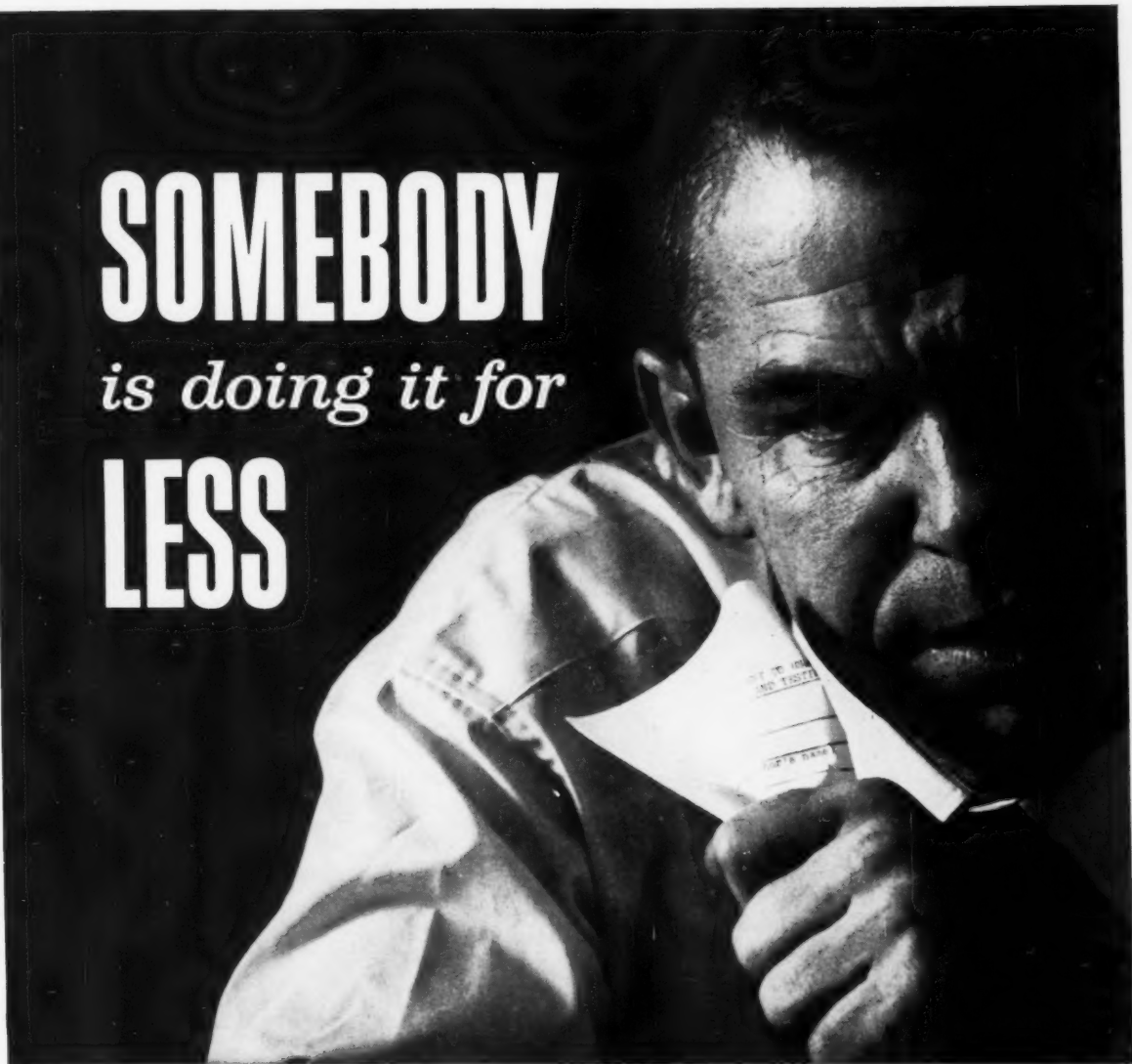
THE PIPE MACHINERY COMPANY

29100 Lakeland Boulevard • Wickliffe, Ohio • Greater Cleveland

SOMEBODY

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LESS



MASTERLINE® 3L Saddle Type Turret Lathe—

Offers maximum operator ease; speed selector for 12 or 24 spindle speeds; separate lever controls for cross and longitudinal rapid traverse. With cross-feeding hex turret, standard tools handle all types of machining. JETracer® (for cross slide, cross-feeding hex turret, or mounted on turret face) handles tapers, contours, steps and combination forms automatically.

Call your Gisholt Representative or write for literature.

And since that somebody competes directly with you, it's time to act. With modern lathes, sooner or later he'll force your hand.

Do you realize that a new Gisholt Turret Lathe is at least 40% more efficient than a 10-year-old machine? You save time and floor space—you reduce rejects, maintenance costs, and skilled labor requirements.

Why not act now? Find out what a new Gisholt can do for you. Join those who are doing it for less.

Write for Literature.



GISHOLT

MACHINE COMPANY
Madison 10, Wisconsin, U.S.A.

What does "Blanchard Ground" mean? Well, a glance at this sample case would show that it means finishes as fine as 2 microns. And a quick check with the optical flat below would show flatness to within 1 light band. What's more, Blanchards provide high precision, high production grinding of materials ranging from glass and stone, thru gems and plastics, as well as ferrous and non-ferrous metals. Equally efficient at hogging, too. Send for "The Art of Blanchard Surface Grinding" and get the whole story.

BLANCHARD GROUND

2MU

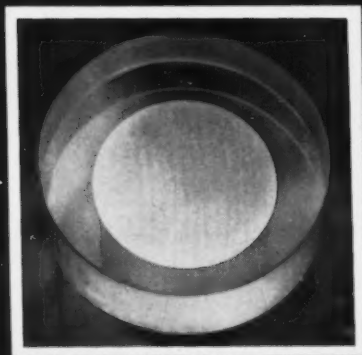
4MU

8MU

15MU

20MU

30MU



PUT IT ON THE

BLANCHARD

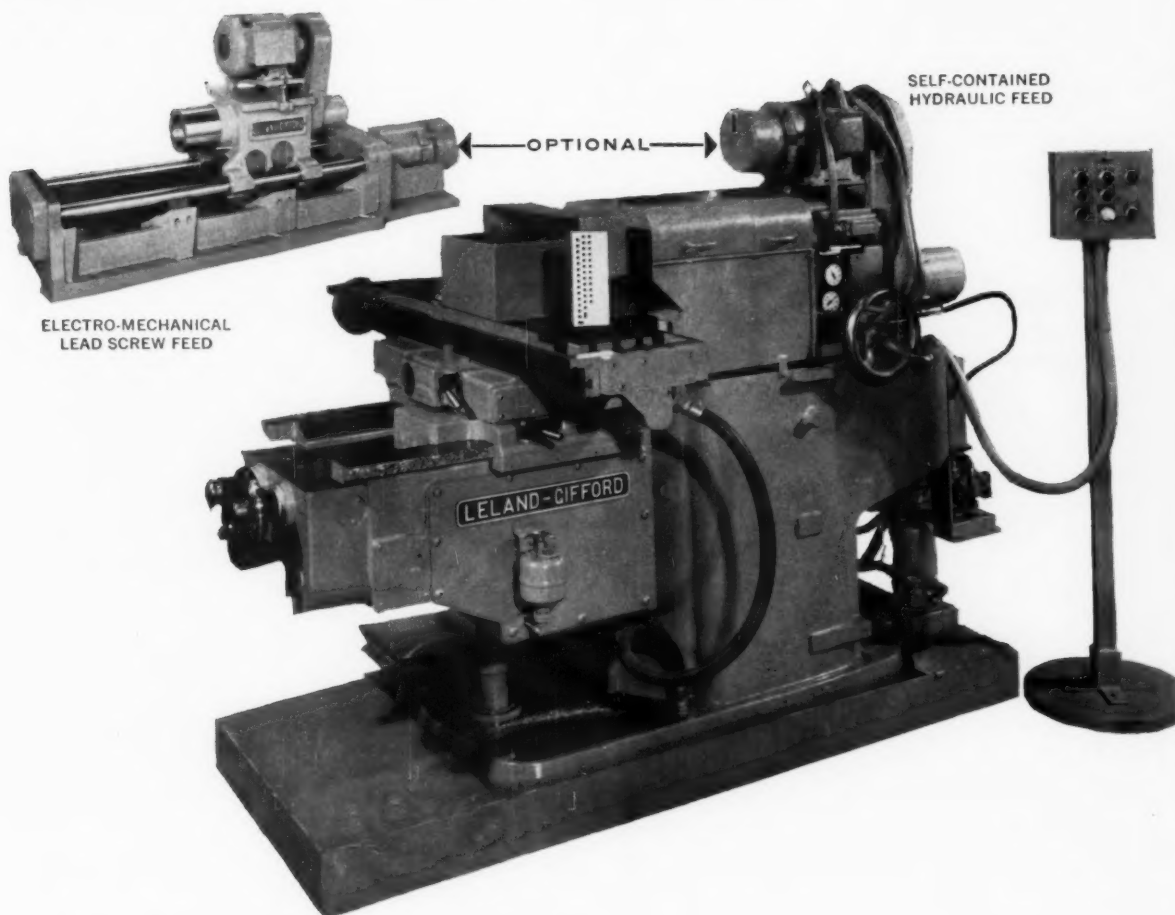
THE BLANCHARD MACHINE COMPANY 64 State Street, Cambridge 39, Massachusetts

NEW

LELAND-GIFFORD

KNEE-TYPE GUN DRILL

- Does High Precision Work
- Handles Many Jobs
- Cuts Fixturing Costs



ELECTRO-MECHANICAL
LEAD SCREW FEED

SELF-CONTAINED
HYDRAULIC FEED

AVAILABLE WITH HYDRAULIC OR LEAD SCREW FEED

For gun drilling smooth, round, straight, deep holes up to $\frac{3}{4}$ " diameter in ferrous or non-ferrous materials, consider the advantages of this Leland-Gifford Universal Gun Drill:

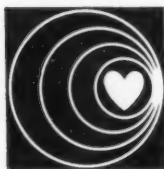
Coordinate elevating, traversing and swiveling of the table eliminates much expensive fixturing. You can handle a wide variety of jobs quickly and

economically.

Available with hydraulic or lead screw feed. Choose the feed unit best for your range of hole diameters and depths.

There are few holes too deep, too small or too accurate to be drilled with this modern, capable gun drilling equipment.

For complete information, write for detailed bulletin — or ask to have an experienced sales engineer call.



LELAND-GIFFORD

WORCESTER 1, MASSACHUSETTS

DRILLING MACHINES

Accuracy of Positioning

Longitudinal Travel:

Greatest error in any inch.....	15 millionths
Greatest error in any 18 inches.....	35 millionths

Cross Travel:

Greatest error in any inch.....	15 millionths
Greatest error in 11 inches.....	35 millionths

Squareness:

Compound slide	20 millionths
Travel, spindle housing.....	50 millionths in 17"
Travel, spindle	30 millionths in 2 1/4"

Spindle Axis:

Runs true	within 3 millionths
-----------------	---------------------



These users measure to one-third of a "tenth" with Moore Universal Measuring Machine

The tolerances shown at the top of this page will be proven in front of you before final acceptance of the machine, as it was with each customer shown at right.

These users will also attest to the advantages of this machine: its capacity for ultra-precise measuring and inspecting of larger workpieces; the choice of an electronic indicator supported on an accurate, rotatable spindle, or a universal microscope for pickup; a combination of rectilinear and angular positioning, making possible the measurement of the most complex contours. All ways are hardened, ground and lapped steel, fitted to hand-scraped cast iron. Table positioning in two directions of travel is by means of master lead screws. Note motorized lead screw drive, offered as optional equipment.

Write today for complete details.

MOORE SPECIAL TOOL COMPANY, Inc.

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Sperry Gyroscope Division, Sperry Rand
Mineola, New York
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Dow Chemical Company... Rocky Flats, Colo.
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Cambridge, Massachusetts
DeVlieg Machine Company. Royal Oak, Mich.
Douglas Aircraft Co., Inc. Charlotte, N. C.
AC Spark Plug Division, General Motors
Milwaukee, Wisconsin
Sangamo Electric Company... Springfield, Ill.
University of California... Los Alamos, N. M.
Raytheon Manufacturing Company
Andover, Massachusetts
Kollsman Instrument Corporation
Elmhurst, New York
A. C. F. Industries, Inc. Albuquerque, N. M.
General Electric Company... Richland, Wash.
Naval Ordnance Plant
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Catmur Machine Tool Corp., Ltd. England
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Chandler Evans Corporation. Hartford, Conn.
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***REPEAT ORDER**

ADD TO YOUR TOOLROOM

JIG BORERS • JIG GRINDERS • MEASURING MACHINES • PANTOGRAPH WHEEL DRESSERS • PRECISION ROTARY TABLES • HOLE LOCATION ACCESSORIES

He's making a Monarch Lathe...



Final spindle runout test. Today's typical limit: .0003" on test bar inserted in spindle, 14" out from nose. Tomorrow's limit? The ultimate that the user's requirements might justify.

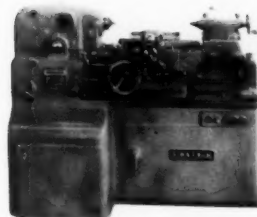
One example of where the extra values come from—in your MONARCH Lathes

Over and over, as a Monarch Lathe evolves, this scene repeats itself with constant variations. Although we ignore no areas in enforcing accuracy standards, we are almost obsessed in our attention to the most sensitive of all—the headstock spindle. True lathe accuracy is out of the question without utmost accuracy here.

In the picture above you see one of the 27 final Spindle-specation tests. And don't forget that this, and every Monarch spindle, has already been checked and rechecked at every step of its production.

Such accuracy is not only a fetish with us, but a special benefit to you. It delivers such finish as to cut considerably—or eliminate—other operations. It lengthens tool life. It contributes to increased production at greater speeds and feeds.

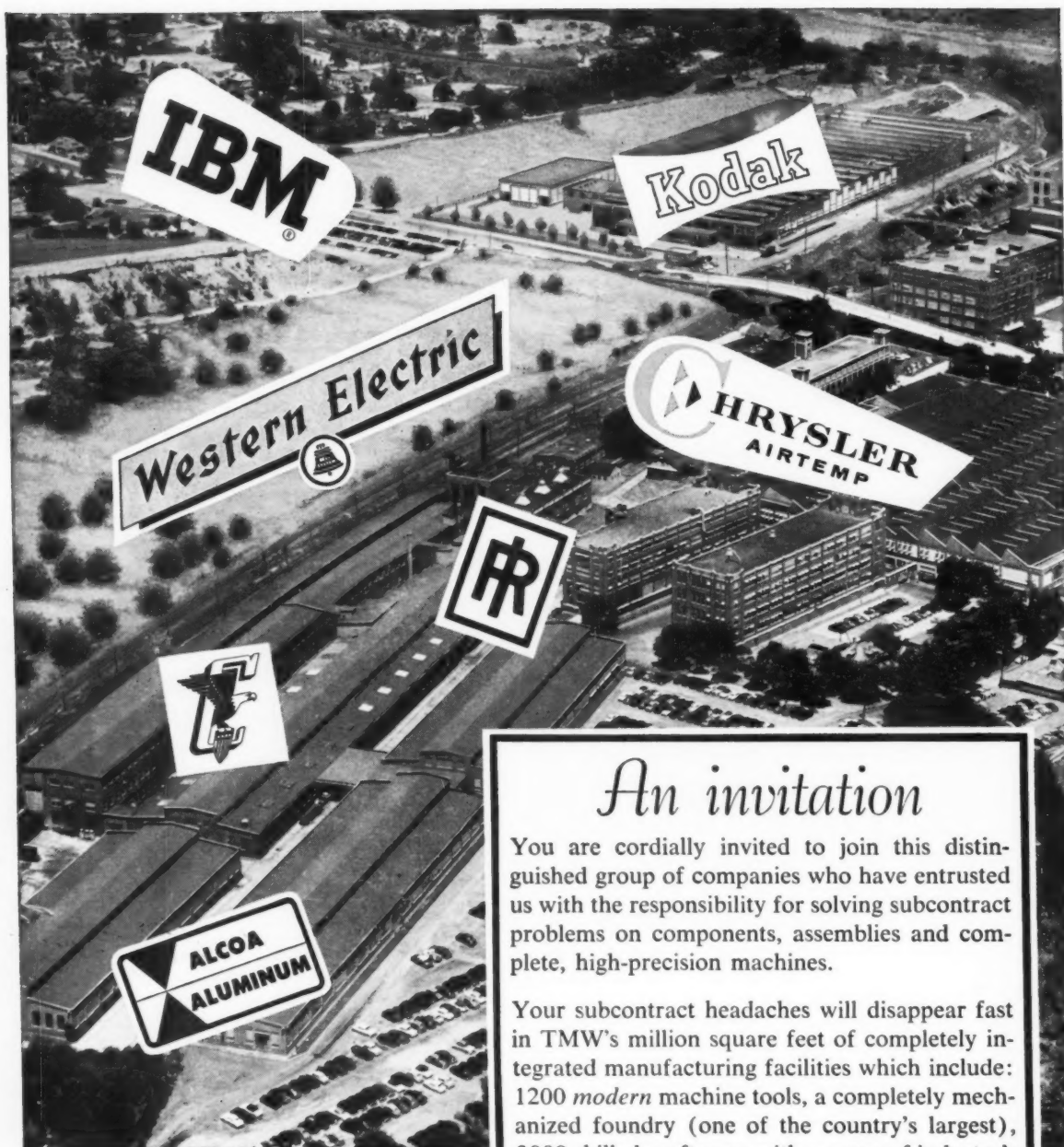
When you invest what it takes for a good lathe today, isn't anything less than the greatest value a false economy? We can prove it on your part, using our machines, in our Turning Clinic here in Sidney. Just write—THE MONARCH MACHINE TOOL COMPANY, SIDNEY, OHIO.



WHEN YOU BUY VALUE
MONARCHS COST LESS



VISIT MONARCH—We'll turn your part to return you profit



An invitation

You are cordially invited to join this distinguished group of companies who have entrusted us with the responsibility for solving subcontract problems on components, assemblies and complete, high-precision machines.

Your subcontract headaches will disappear fast in TMW's million square feet of completely integrated manufacturing facilities which include: 1200 *modern* machine tools, a completely mechanized foundry (one of the country's largest), 3000 skilled craftsmen with a corps of industry's top designers and engineers.

TMW's facilities and 65 years' experience in precision (tolerance to 10ths) manufacturing is available to you *now*, on a short or long-term basis. For more details, or for new Facilities File Folder, call or write: Textile Machine Works, Contract Division, Reading, Penna.



TEXTILE MACHINE WORKS
CONTRACT DIVISION • Reading, Pennsylvania

NEW **LOCTITE**[®] METHOD



IMPROVES RELIABILITY OF PRESS FITS... CUTS COSTS ...without A Penny Invested in Equipment!

Simply apply a few drops of **LOCTITE Sealant** to press fit assemblies. Look at these production assembly advantages:

- Greatly increases reliability of interference fits and other methods of metal-to-metal assembly.
- Requires no expensive equipment—the plastic bottle is the applicator. Can be used for automatic or mass application with simple “around-the-shop” parts.
- Increases allowable tolerances—reduces machining costs.
- Reduces materials costs—minimizes design requirements.
- Facilitates assembly of delicate parts—reduces danger of deformation.
- Facilitates proper concentric fit of mated parts in line-to-line fits—this liquid-turned-to-solid mates parts better than any metal-to-metal contact possible.

... and parts can be disassembled with standard tools and techniques.

WHAT IS LOCTITE? **LOCTITE Sealant** is a penetrating liquid resin with low viscosity that hardens when confined between closely fitted metal surfaces. It “wicks in” between the most closely mated of matched precision surfaces and hardens into a strong, heat-, oil-, grease-, solvent- and vibration-resistant bond. **LOCTITE** completely fills the

space between the surfaces... adds its sheer strength to that of the press fit. There are no solvents to evaporate—no catalyst to mix.

On the production assembly line and in other areas, too, the **LOCTITE Method** replaces and improves many different mechanical means of *locking—retaining—sealing*. **LOCTITE Sealant** has already brought these benefits and savings to such leading companies as:

Bendix Corporation
Consolidated Diesel Electric Corp.
The Maytag Company
Westinghouse Electric Corp.
General Dynamics Corporation,
Electric Boat Division
Reeves Instrument Corporation

Norge Division, Borg-Warner
Remington Rand Univac
Philco Corp.—Government &
Industrial Div.
General Electric Company
Raytheon Mfg. Co.
McDonnell Aircraft Corporation

Veeder Root, Inc.

Details on your particular application bring immediate response from our Application Engineering Dept. Or, better yet—make your own convincing test. Mail check for Test Kit No. 10-10 (\$16.50 complete).



American Sealants Company • 207 North Mountain Road
Hartford 11, Connecticut

LOCTITE[®] SEALANT

MACHINERY, July, 1961

For more data, circle this page number on Readers' Service Card.

61

NEW TOOL STEEL SERVICE

reduces
heat treating
costs



The man who heat treats many different tools...



can realize major savings with Crucible's new Tool Steel Service.



He'll operate his furnaces more efficiently and profitably because



he'll now be able to heat treat many more tools at one time.



He'll know exactly how each grade responds to heat treating.



—so he'll certainly get more consistent results by employing time-tested techniques.

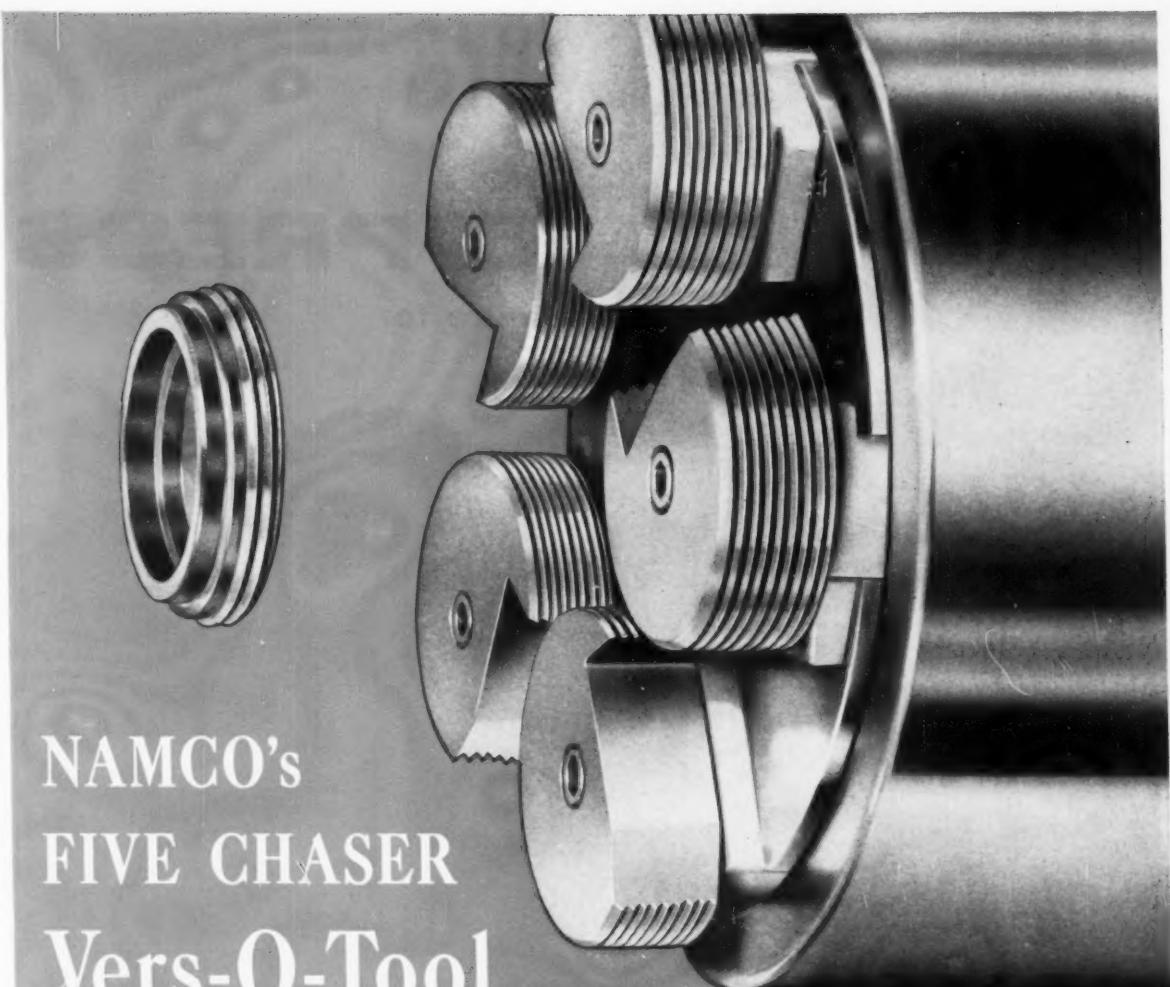


All by standardizing on a few basic tool steel grades!

To find out how
this new Tool Steel
Service can cut
your heat treating
costs, call in a
CRUCIBLE
Service Engineer.

CRUCIBLE STEEL COMPANY OF AMERICA

Branch Offices and Warehouses: Atlanta • Baltimore • Boston • Buffalo • Caldwell, N. J. • Charlotte • Chicago • Cincinnati • Cleveland • Columbus • Dallas • Denver • Detroit • Erie, Pa. • Grand Rapids • Houston • Indianapolis • Los Angeles • Miami • Milwaukee • Minneapolis • New Haven • New York • Philadelphia • Pittsburgh • Portland, Ore. • Providence • Rockford • Salt Lake City • San Francisco • Seattle • Springfield, Mass. • St. Louis • E. Syracuse • Tampa • Toledo • Tulsa
CRUCIBLE STEEL OF CANADA, LTD., SOREL, QUEBEC, CANADA

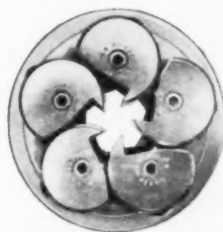


NAMCO's FIVE CHASER Vers-O-Tool...

Lear Romec's Solution To Tough Threading Tolerances

Charles Van Auken, Assistant Chief Production Engineer at Lear Romec Division of Lear, Inc., Elyria, Ohio tells us: "Threading specs for this lock-nut for a jet engine vane pump are tough . . . 1½-12N-3A, +.0000 and -.0045 on pitch diameter, 100 RMS on surface finish. Naturally, we use a NAMCO 5-Chaser Vers-O-Tool. It consistently surpasses the specs and sets up in a *fraction* of the time required for a 4-chaser tool. On threading jobs like this, the 5-Chaser Vers-O-Tool is our margin of profit!" Anyone who has ever used a NAMCO 5-Chaser Vers-O-Tool will agree. There just isn't anything that threads better. And, there are good reasons . . . all outlined in our new Bulletin DV-1 "Five Circular Chaser Threading". At your request, we'll be happy to send you a copy.

MACHINERY, July, 1961



National Acme

THE NATIONAL
ACME COMPANY
179 E. 131st STREET
CLEVELAND 8, OHIO

Sales Offices: Newark 2, N. J., Chicago 6, Ill., Detroit 27, Mich.

For more data, circle this page number on Readers' Service Card.

this modern

CLEVELAND PRESS

embodies every essential feature for

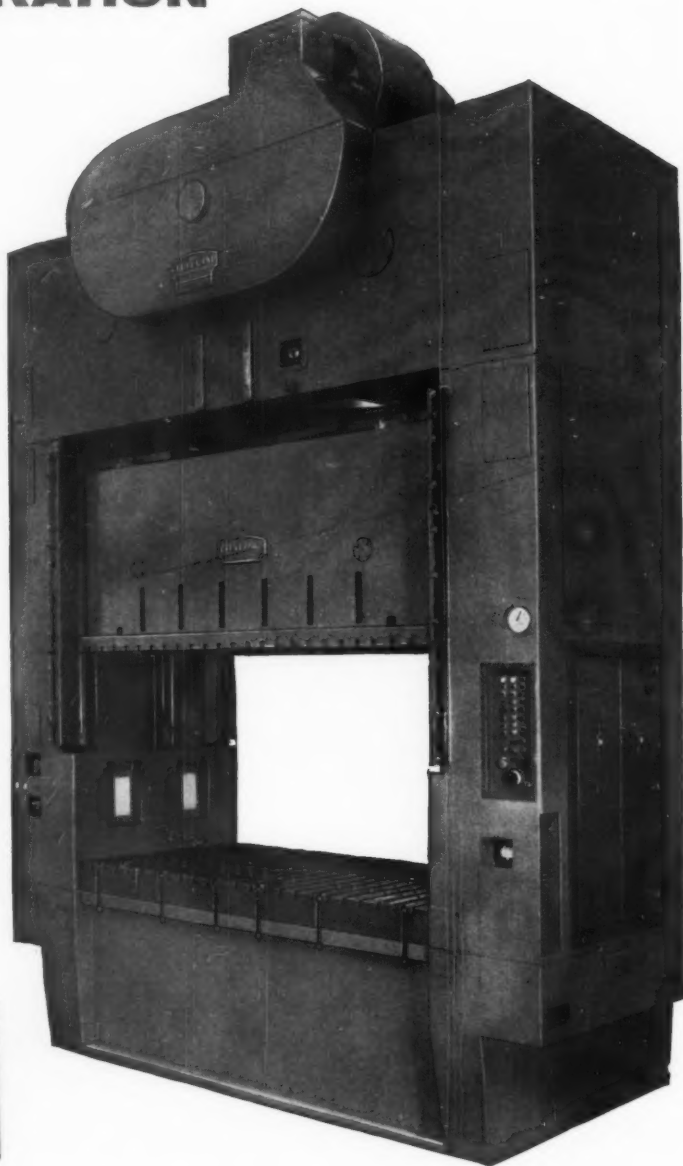
EFFICIENT OPERATION

Designed to produce many different types of stampings, this modern Cleveland Four Point Press already has proven its cost-cutting efficiency in automotive, appliance and other industrial pressrooms.

Features on this press are:

- Electrically controlled air-operated Cleveland (patented) Drum Type Clutch with spring loaded brake
- Air counterbalanced slide
- Pneumatic cushion in the bed, with controls for separate operation
- Auxiliary air brake on flywheel
- Lighted die area
- Gears completely enclosed, spray lubricated
- Stroke indicator
- Built to JIC Standards

Cleveland Four Point Presses can be furnished in a wide range of sizes, with capacities to suit particular requirements by modifying the stroke, adjustment, bed and slide areas. All models have this in common — maximum accuracy and die life . . . minimum maintenance and per-part costs . . . that's why it pays you to look into the advantages Cleveland Presses offer.



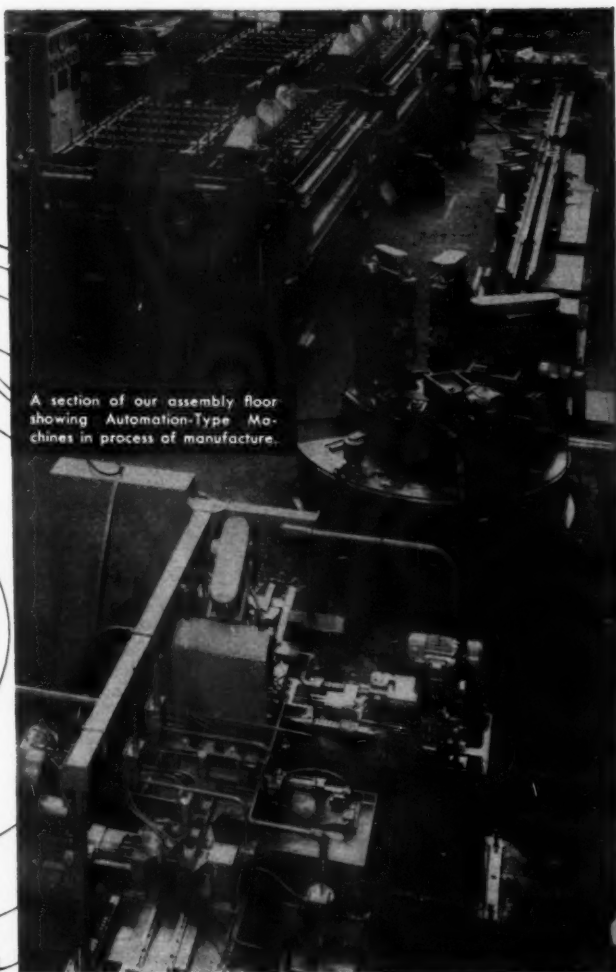
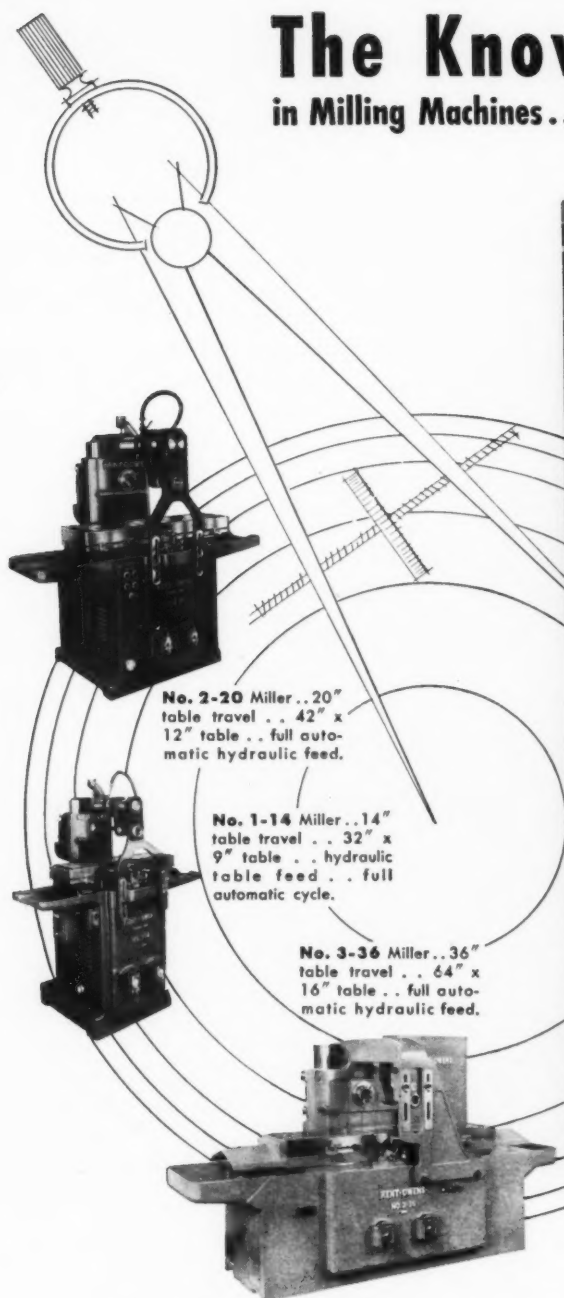
E. 40th and St. Clair Avenue, Cleveland 14, Ohio

4-1518A

500-ton capacity,
24" stroke with 15"
adjustment; shut-height
61½"; slide and bed both
72" x 144".

The Know-How Dimension

in Milling Machines .. Special Machinery .. Automation Equipment



.. makes the difference in cutting costs .. increasing production

Know-How, born of years of experience, abetted by sound and imaginative design and quality manufacturing standards ... is the reason why many of our customers, representing a wide and diversified coverage of industry, come back to us again and again for answers to their production problems.

When you are considering procurement of machinery for your milling needs ... or seeking the solution to

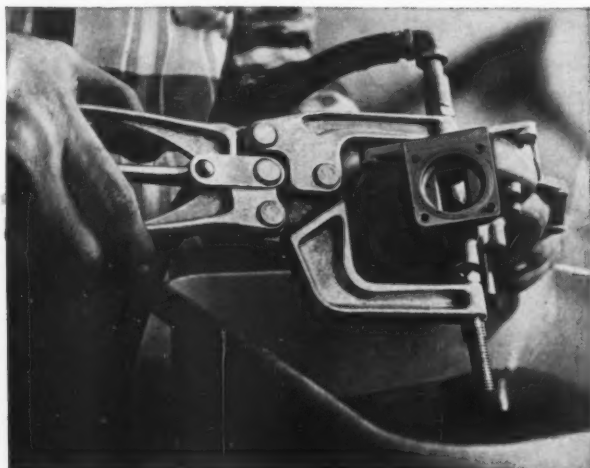
other production problems ... you may wish to consider a Kent-Owens Milling Machine or a Special Machine designed for a distinctive and individual application. Contract Machine Building (customer designed equipment) is another of our specialties.

Write or call ... Kent-Owens will be pleased to quote your requirements. Kent-Owens Machine Company, Toledo 10, Ohio.

KENT-OWENS

*Designers and Builders of
Milling Machines and Special Machinery*

Look what clamps are doing!

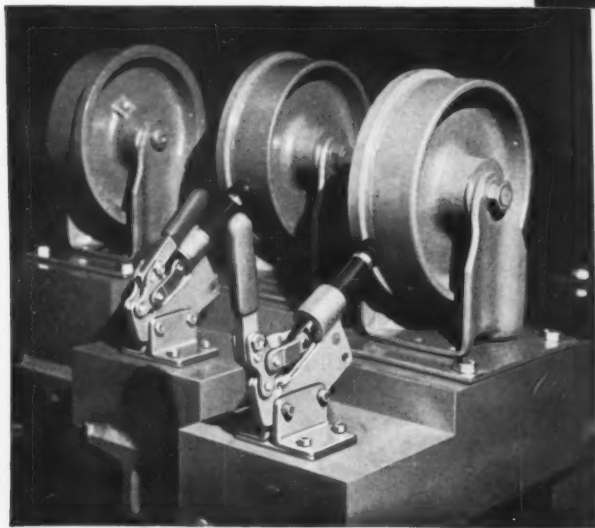
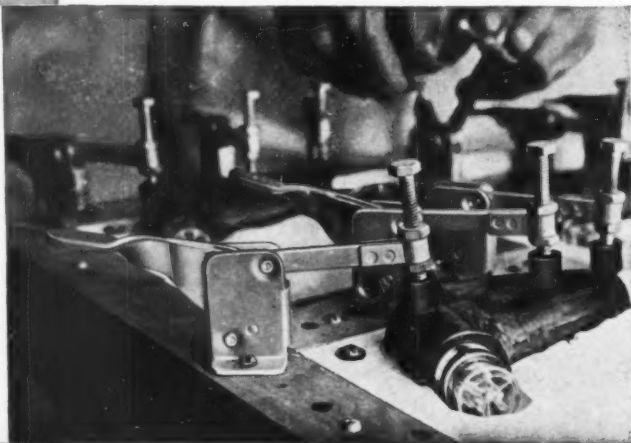


*Practical uses of Wespo
Toggle Clamps and Pliers that
may suggest ways you can save*

Toggle plier serves as low cost fixture for testing castings
The air line is connected through one jaw of a Wespo Model 522 Toggle Plier. The plier is then clamped onto the casting and air applied by a foot control. Immersing the casting into a tank quickly spots any defects. Patented "Quick trigger" feature of the Model 522 instantly releases the casting; speeds testing. Rugged, lightweight Wespo toggle pliers are available in various jaw capacities and sizes.

Holding these glued parts together while drying is a simple task with Wespo Horizontal Bar-Type Toggle Clamps. Neoprene-capped spindles prevent damage to plastic surfaces, yet securely hold the parts during the drying operations. Wespo toggle clamps are available in more than 80 types and sizes. So, the next time you think clamps, think Wespo!

Simple, low cost "parking brake" for this track-operated frame is provided by a Wespo Push-Pull Clamp equipped with a neoprene-capped spindle. "Brake" is quickly applied or released by a simple flick of the wrist. Wespo Push-Pull Clamps are available in various sizes and holding pressures and are ordinarily used on holding fixtures where push or pull clamping is required.



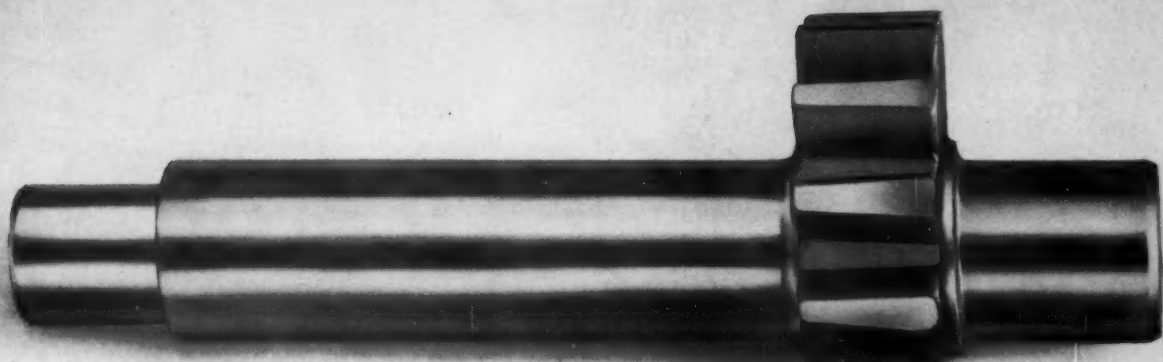
FREE CLAMP CATALOG!

*Ask your Wespo distributor
for your free copy of this
16-page Wespo catalog. It
will help you quickly select
the right clamp for every
clamping job.*



WESPO

DIVISION OF VLIER ENGINEERING CORPORATION
26935 W. Seven Mile Rd., Detroit 19, Michigan
Formerly West Point Manufacturing Company



THE Gleason Revacycle® method and its machine present the fastest way known for cutting precise straight bevel gears.

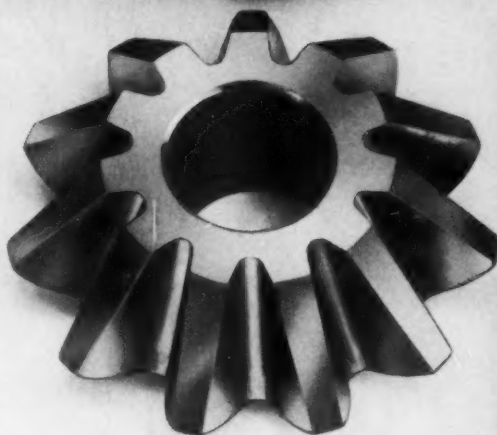
The Revacycle cutter holds roughing, semifinishing, and finishing blades. One revolution of the cutter completes a tooth space in 2.6 seconds. In fact, on smaller pieces, you can cut even faster . . . and complete as many as four tooth spaces in a single cycle at less than $\frac{1}{2}$ second per tooth!

This completely automatic Gleason machine can frequently replace a tandem of roughing and finishing machines . . . thereby saving considerably on capital investment.

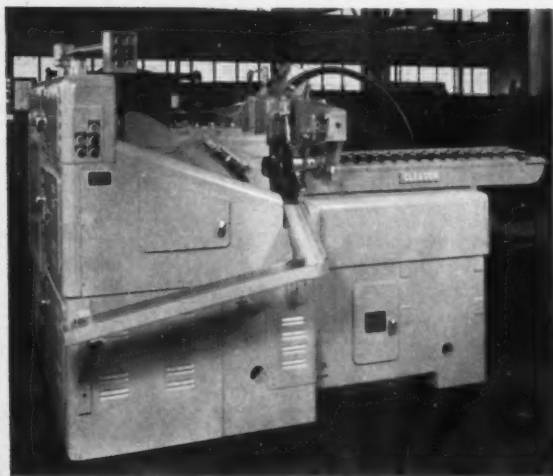
Best of all, to get this speed and economy you need sacrifice nothing in accuracy. The Revacycle method produces localized tooth bearing which permits any practical assembly tolerances while avoiding load concentration at the ends of the teeth. And, you get exact reproduction piece after piece, day after day.

The machine accepts a wide range of work: diameters up to 10" at a 5 to 1 ratio and face widths up to 1.25".

For complete background and data, write for a bulletin. Gleason engineers will help you with details on any specific applications.



How to cut a bevel gear tooth in 2.6 seconds



1.2 seconds is all it takes to dechuck a finished piece in a new blank with the automatic loading attachment on the 109 Revacycle Machine, arranged for cutting steering segments.



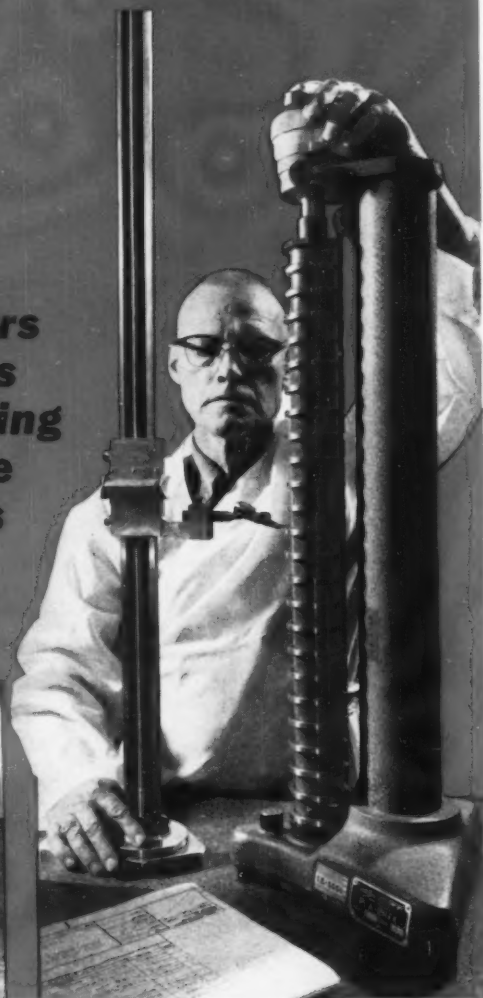
GLEASON WORKS

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**WHERE PRECISION
IS PARAMOUNT
you'll find
PLA-CHEK® GAGES**

example
**HUGHES
AIRCRAFT
COMPANY**

**where for 10 years
PLA-CHEK Gages
have been speeding
inspections while
guarding Hughes
precision and
quality**



Just as the Sentinels of Freedom (at left) stand guard over America's security, so do the PLA-CHEK Gages (center) in one Hughes Inspection room guard the precision and quality of these Falcon Missiles, manufactured by Hughes Aircraft Co.

Nowhere will you find precision and accuracy more demanding than in the manufacturing of guided missiles and airborne electronic armament systems. And volume production demands speed. These are reasons why you'll find so many Cadillac PLA-CHEK Gages at work in the plants of Hughes Aircraft Company.

Ten years ago the first PLA-CHEK went to work for Hughes. Today 120 are in daily use speeding inspections and guarding precision at various Hughes' plants. Here's proof of PLA-CHEK performance.

Speedy inspections? Yes! PLA-CHEK Gages can be set 5 to 20 times faster than other methods of com-

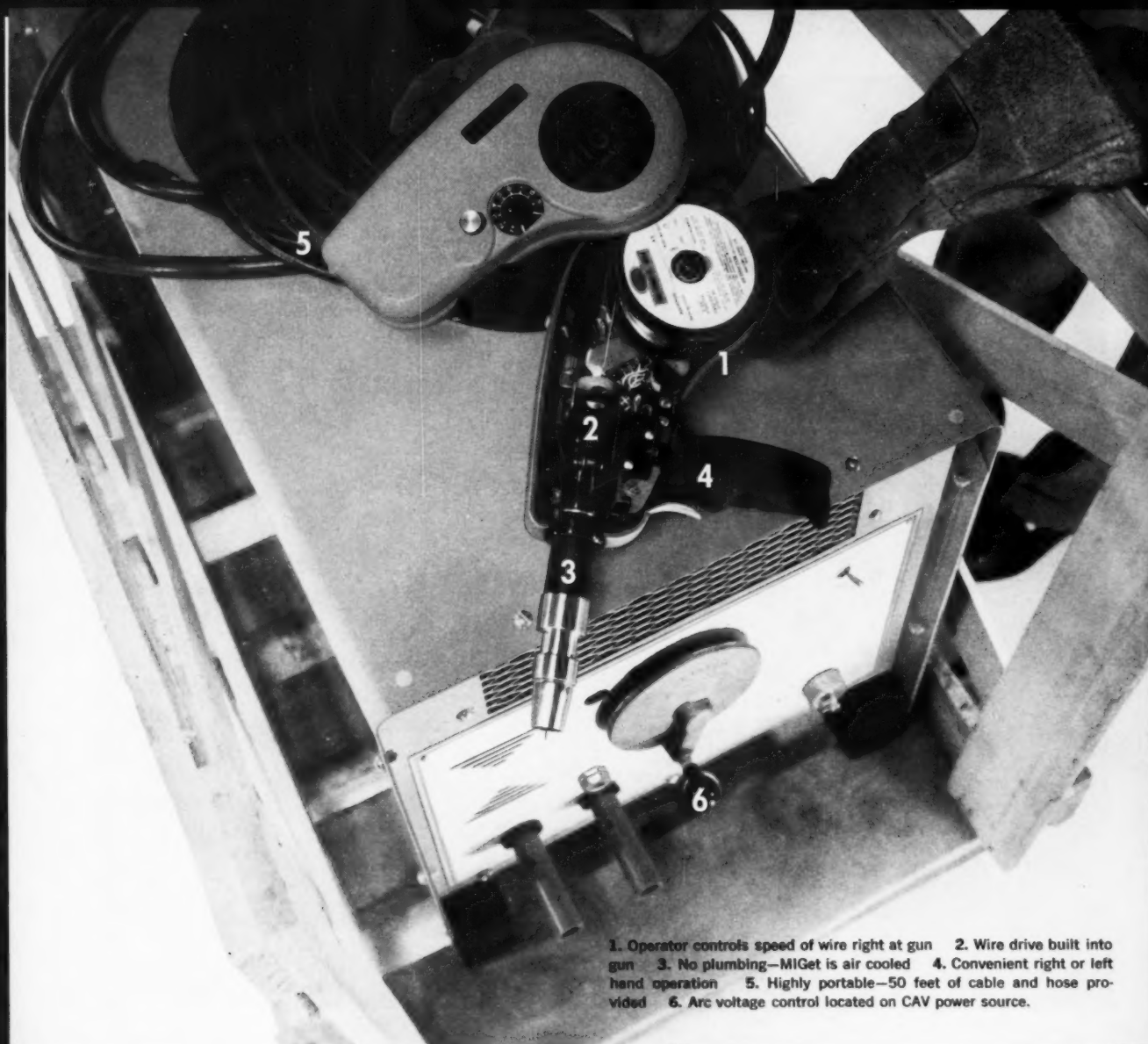
parable accuracy. Precision? Yes! PLA-CHEK Gages are *guaranteed* accurate to .00005" through the entire range of the 6", 12" and 18" sizes—to .0001" through the range of the 24" size. The 36" and 48" sizes are *guaranteed* accurate to .0001" in any 24" length and to .0002" over their entire range.

PLA-CHEK Gages are available in a full range of sizes to meet every inspection and layout requirement either at the surface plate or the machine. Let us tell you how you, too, can speed inspections, maintain extreme accuracy, guard the quality of your work and *save money* with PLA-CHEK Gages. Write for complete, detailed literature.

Cadillac

GAGE COMPANY

P.O. BOX 3806 • DETROIT 5, MICHIGAN



1. Operator controls speed of wire right at gun 2. Wire drive built into gun 3. No plumbing—MIGet is air cooled 4. Convenient right or left hand operation 5. Highly portable—50 feet of cable and hose provided 6. Arc voltage control located on CAV power source.

DO HI-SPEED AIRCOMATIC WELDING ANYWHERE—\$995* with new MIGet UNIT PACKAGE! (no separate control needed) only **\$995***

Airco now gives you the simplest, lowest price gas-shielded metal-arc welding package in the industry —

- (1) Hi-speed highly portable MIGet welding gun, with handy knob to adjust wire feed speed; model AH20-E.
- (2) New Aircomatic MIGet CAV power source, with control to adjust arc voltage.

The new MIGet UNIT PACKAGE enables you to make numerous short-length welds... at a remarkably low cost. You can work up to 50 feet from the power source, on anything from radar antennas to crawl-in tunnels.

You can weld mild steel with Dip Transfer using CO₂ or AG25; aluminum with Spray Transfer or Dip Transfer using argon; stainless steel with Dip Transfer using AG1.

The MIGet gun connects directly to the power source. It weighs only 2½ pounds. Handles .030" and 3/64" aluminum wires, and .030", .035" and .045" hard wires. It is rated at 200 amperes 100% duty cycle.

The power source, in which the "welding current takes care of itself," is a single phase, DC rectifier, CAV type, rated at

200 amperes 60% duty cycle. Reactance for Dip Transfer is built in.

Here is Aircomatic-quality gas shielded metal arc welding at an unmatched low price of \$995!*

Airco — and only Airco — makes everything you need for any kind of welding. Call your nearest Airco office or Authorized Airco Distributor. Look in your Classified Telephone Directory under "Welding Equipment and Supplies" for your nearest Airco representative.

*Zone I price. Zone II price—\$1015.00



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SALES COMPANY**

A division of Air Reduction Company, Incorporated

150 East 42nd Street, New York 17, N. Y.

More than 700 Authorized Airco Distributors Coast to Coast

On the west coast—Air Reduction Pacific Co., Internationally—Airco Co. Int'l., In Canada—Air Reduction Canada Ltd. • All divisions or subsidiaries of Air Reduction Co., Inc.

It's
**WHAT
YOU
DON'T
SEE**
that counts!

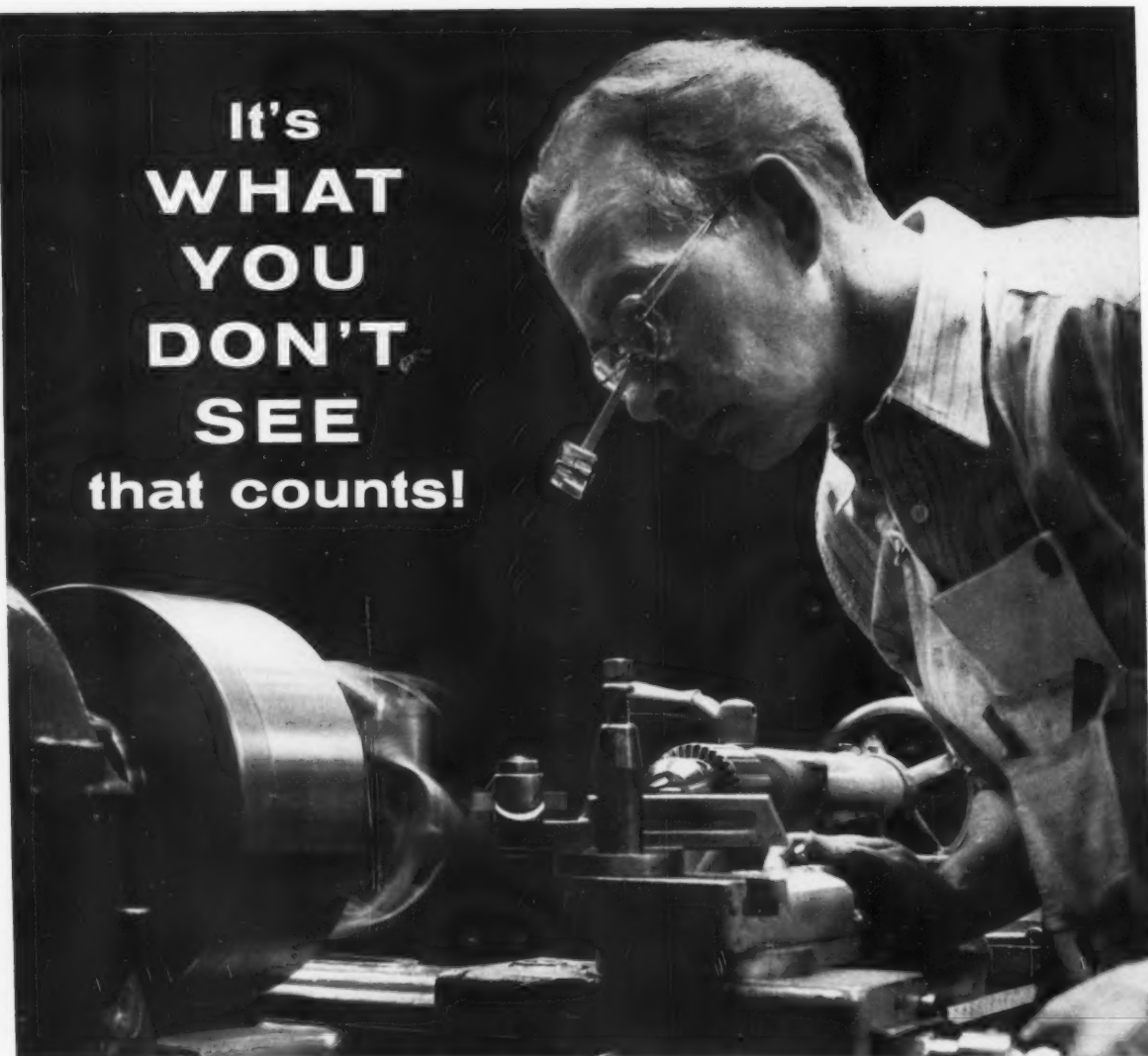


Photo from LEARCAL DIVISION, LEAR INC., Los Angeles

Quality control and production records can quickly prove the efficiency of South Bend 16" Lathes. What you can't see is their *dependability* that assures low cost precision machining for years to come. They can do it because of such features as—

- Integrity of manufacture—honest workmanship using the finest materials.
- Spindle bearings designed specifically for precision work—microfinished sleeve type for close tolerance, *fine finish* work.
- Built to take it for *proven* low maintenance.
- Trouble-free belt drive to the spindle—quiet, no vibration, no gear marks.
- Write for catalog of South Bend Lathes, milling machines, shapers, drill presses and pedestal grinders.

Specifications	16" Lathes
Collet capacity	1 1/8"
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- One Hundred and Forty-Eight Fact-Filled Pages
- Who Buys What?
- Twenty-Five Hundred Naval Gun Factory Tools
- Major Tax Changes Unlikely



Keeping up with Washington

Loring F. Overman

OFF THE PRESSES in Washington is the first of four studies whereby the Business and Defense Services Administration hopes to present a complete picture of the machine tool industry—past, present, and future; worldwide and domestic.

Volume I is entitled "World Trade in Machine Tools, 1955-1958."

Volume II is to be a study of production and consumption in machine tool producing countries throughout the world.

Volume III will be a study of industrial factors in producing countries.

Volume IV is to be a comparison of United States industrial factors with those of other major producing countries.

One Hundred and Forty-Eight Fact-Filled Pages

The initial volume consists principally of 148 pages of charts and tables that analyze the world machine tool trade vectors between countries importing or exporting machine tools. The intent, as explained by BDSA officials, is "to provide under one cover strictly comparable statistics showing the volume and trends in the world market demand for machine tools, the relative positions of the United States and other world suppliers, and the principal markets for these tools."

As a prelude to the tables detailing the types of machine tools required by importing countries and their present sources of supply, the World Trade summary points out how and why the United States has lost its long-held position as the leading supplier to world markets. West Germany and the United States, in that order, far outranked other suppliers to the world market during the 1955-1958 period. During that period they supplied 31 and 28 per cent, respectively. The United Kingdom ranked third with 12 per cent, and Switzerland fourth with 9 per cent. The remaining 20 per cent was supplied by (in order of rank) Czechoslovakia, Italy, France, Sweden, U.S.S.R., Belgium-Luxembourg, Netherlands, Denmark, and Japan.

Who Buys What?

The new BDSA study goes into great detail to show which country buys what type of machine, and in what quantities. For example, here is one observation:

"Although the four-year period covered may be too short to indicate long-term trends, the figures show that world trade in forming type machines increased at a far greater rate than the trade in cutting types between 1955 and 1958." A table supporting the conclusion shows a rise of 54 per cent in exports of forming type tools, as compared with an increase of 35 per cent in cutting type tools.

Seventy-Cent Bargain

At the seventy-cent price quoted by the superintendent of documents, Government Printing Office, Washington 25, D. C., "World Trade in Machine Tools" is a bargain in world market information. Its usefulness should not be limited to those involved in marketing machine tools. Because of the basic role of machine tools in industrial economics, it is believed that the data in this publication will prove to be useful as a market indicator in many different fields, particularly other industrial machinery and equipment.

The basic studies were made under the direction of Philip A. Bennett, director, Metalworking Equipment Division, BDSA. Coordination and final review were exercised by B. K. Haffner, chief, Program Planning and Policy Branch, Metalworking Equipment Division, BDSA. Attractive cover illustrations are credited to the National Machine Tool Builders' Association.

Twenty-Five Hundred Naval Gun Factory Tools

Machine tool industry representatives, together with officials of the Metalworking Equipment Division, BDSA, spent three days recently surveying some 2500 machine tools which will be idled by the closing of the historic Naval Gun Factory in the national capitol. In constant operation for 160 years, the gun factory is a victim of the new age of missiles, rocketry, and orbital flight. In its day the factory was the Navy's principal source of 16-inch guns and other outsize armament for battleships, cruisers, and other capital ships.

With few exceptions, according to Harry Hawkins, BDSA Metalworking Equipment Division executive, the 2500 machine tools will be dispersed as needed among other Bureau of Weapons plants.

Major Tax Changes Unlikely

The swiftly moving calendar, with July 1 as the deadline to continue corporate income-tax rates, as well as excise taxes on alcoholic beverages, cigarettes, and other items, is expected to stymie any major changes in tax legislation for some time to come. About all that can be expected of Congress, observers believe, is that excise and corporate rates will again be extended for a period of one year, to permit further consideration of an over-all tax package.

Ways and Means Committee hearings turned up much opposition to the Administration's proposals for tax revisions. It appeared that business would prefer to continue under present rates until plans for a real tax overhaul can be completed, rather than to settle for half a loaf which might become as nearly permanent as the present "temporary" excise and corporate rates.

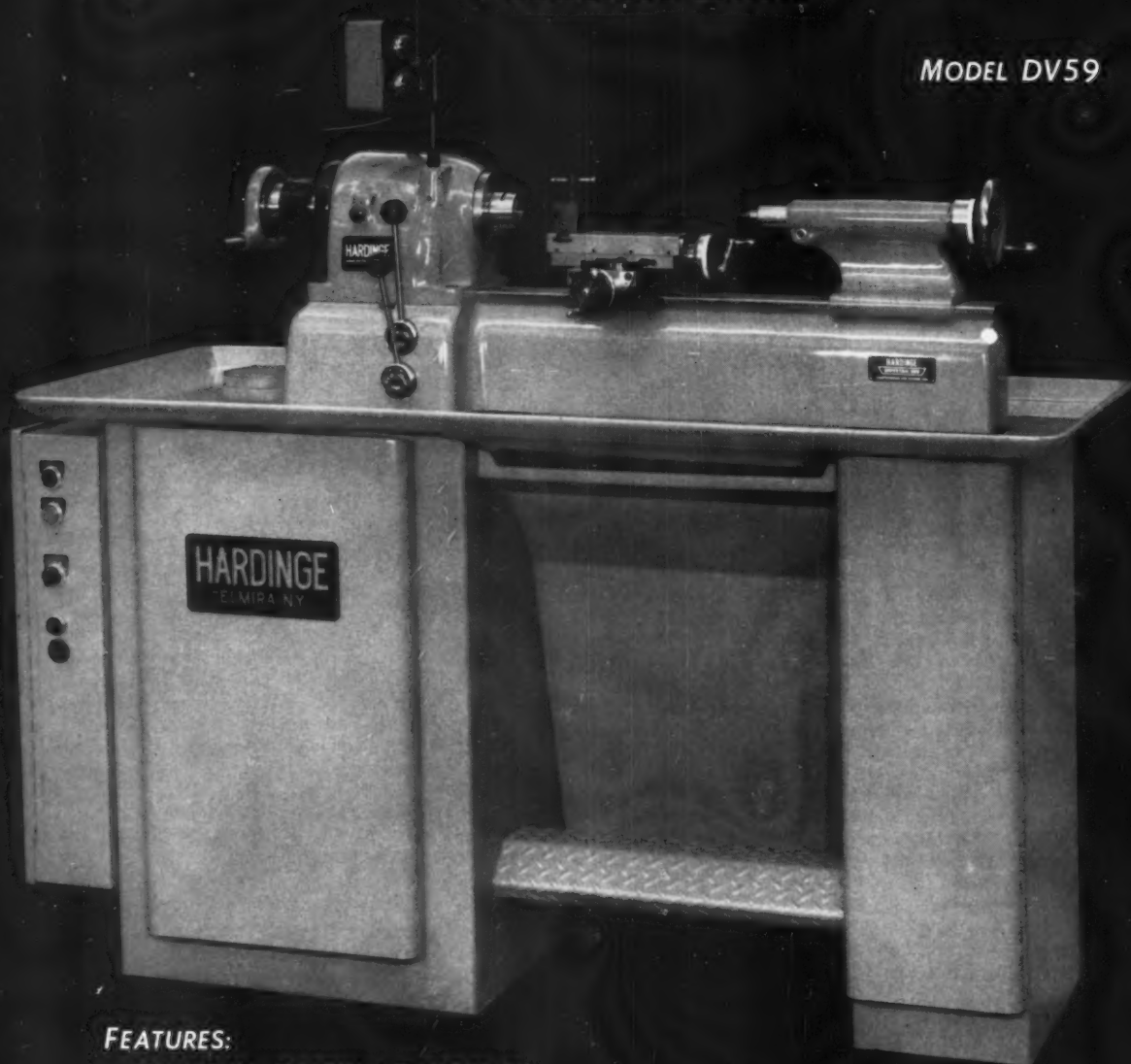
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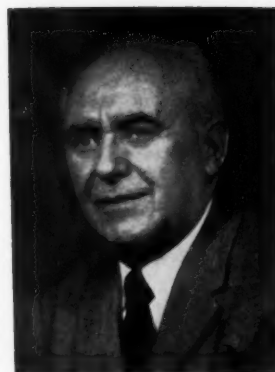
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What's New in Aircraft and Missile Manufacture?

SOMEONE has said that scientists uncovered the secrets that opened the door to the missile age and engineers devised the marvels that climbed to the stars. But theories and blueprints are of no value unless they are translated into successful air-space vehicles.

Here is where practical knowledge and ability come to the fore. Production men familiar with manufacturing processes, and particularly processes that have been developed to meet space-age problems, are called upon to build the satellites and intercontinental ballistic missiles. Other practical men construct the equipment that gets the space vehicles off the ground.

Back in 1938, **MACHINERY** published its first complete issue dealing with the production methods of the aircraft industry. There has been an annual issue ever since devoted to that industry. Of late years, manufacturing operations on missiles and satellites have been included. These annual issues together constitute an encyclopedia of information about the manufacturing in the aircraft industry yesterday and today.

This issue deals with such advanced practices as electromagnetic forming and plasma metallizing of metal components. One article describes the close procedure that must be followed in finishing valves that meter out cryogenic liquid rocket-motor propellants. Another article deals with the modern forging methods developed for working "superalloy" and "exotic" metals. Still another article describes a self-contained machine which runs on a track that adjusts itself to the contours of long airplane panels. It insures accurate indexing over curves rather than only in straight lines.

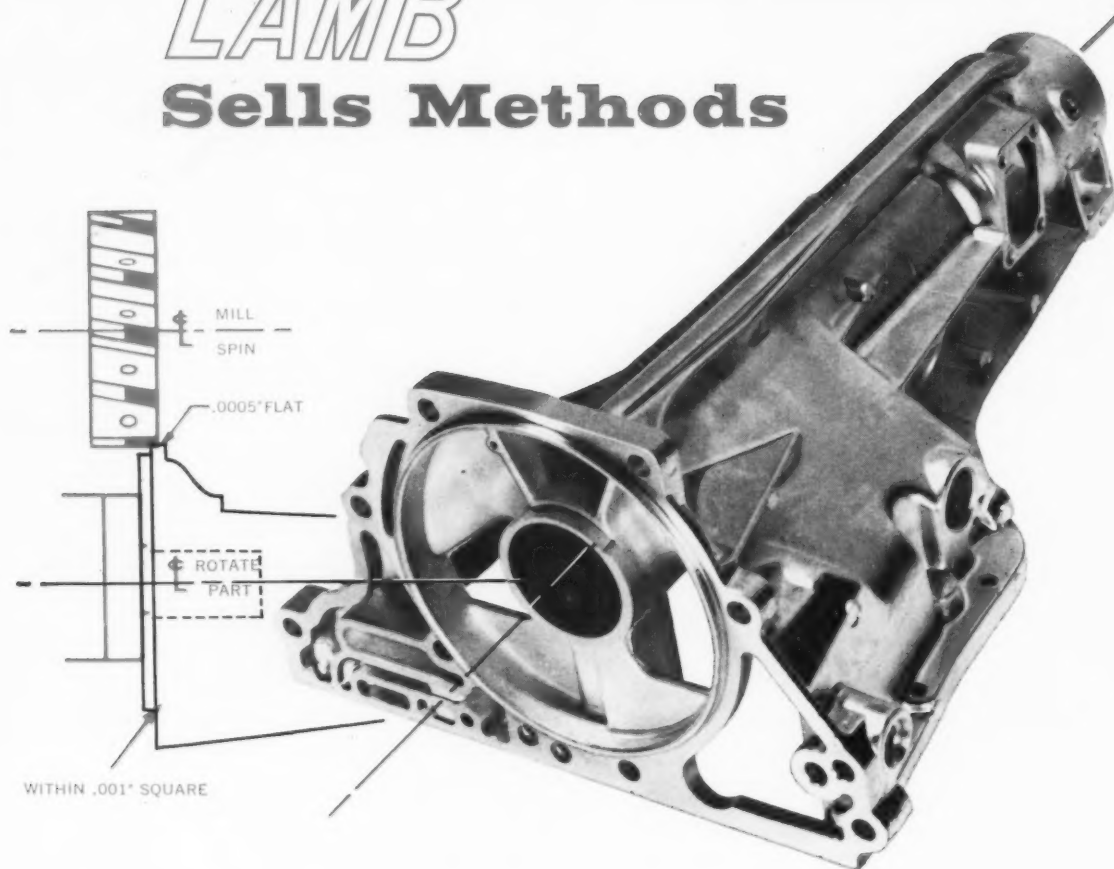
Most of the processes dealt with, of course, have applications in other fields besides the aircraft and missile industries. An understanding of their potentialities is advantageous to the well-informed engineer and production executive.

Charles O. Herb

EDITOR

LAMB

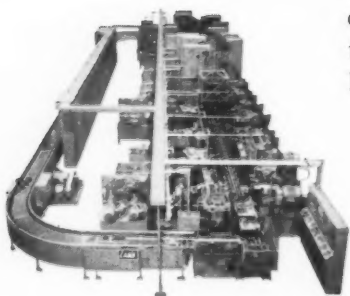
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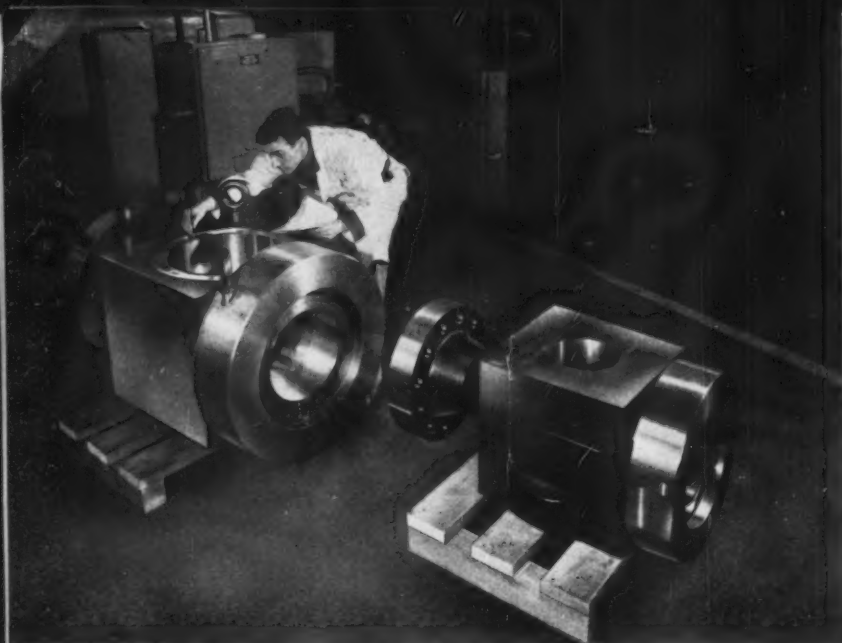
Cryogenic liquid rocket-motor propellants are controlled and metered in exact proportions by accurately machined ball valves, some of which must operate reliably at temperatures below -400 degrees F. and at pressures up to 10,000 psi. Close tolerances and extremely smooth seating and sealing surfaces have been combined with unique design features to provide a leakproof valve vital to our race to space. Versatile equipment and machining practices serve the manufacturer equally well in short-run military work or in long-run commercial production

HAROLD W. BREDIN
Associate Editor

WHEN the Atlas intercontinental ballistics missile reaches the height of its trajectory, two small vernier rocket engines operate to make precise velocity adjustments that, in effect, "aim" the missile to within a 2-mile target area after travel-

ing 6000 miles or more. When a rocket engine of the manned spacecraft X-15 is fired, the pilot controls the flow of the dual propellants (liquid oxygen and liquid ammonia) to the combustion chamber in exact proportions. When one of the 1,500,000-pound thrust rocket engines for the six-engine (9,000,000-pound thrust) interplanetary vehicle Nova is tested, thousands of pounds of liquid oxygen and kerosene type fuel must be accurately metered and the flow shut off in a fraction of a second. Each of these and other exacting functional achievements throughout our space program are being accomplished through fine control of cryogenic liquids by means of precision-machined, leakproof ball valves designed and manufactured by Hydromatics, Inc., Bloomfield, N. J. Contributing to this company's ability to uniformly maintain close tolerances and close finishes is a plant well equipped with modern machine tools, 50 per cent of which are less than a year old.

The largest and probably the most unique ball valves ever produced were the set of eight designed for use in the test stand for the Nova engines. Made of Type 304 stainless steel and having a combined weight of 40 tons, these 8- to 14-inch valves required precise contour machining of the sealing and seating surfaces with finishes as fine as 4 micro-inches. Surfaces this



smooth were particularly necessary on the huge ball-shaped members, which weigh up to 1/2 ton each.

Bodies for two of the Nova test-stand valves are shown in Fig. 1; and in Fig. 2, a precision milling operation is seen being performed on a third valve in the set on a DeVlieg Jigmil. A milling cutter equipped with throw-away carbide inserts is being used. Wherever possible throughout the plant throw-away inserts are employed, with satisfactory results being obtained with grades such as Carboloy No. 350 and 370. Ports

in the side of the valve body (Fig. 2) for the purpose of retracting the seats were bored in the same Jigmil setup. These seats are dispersion-coated with Kel-F, a plastic that allows the valve to operate with no leakage at temperatures in the cryogenic range.

Generally, initial machining of large ball-valve components for use in both military and commercial valves is done on vertical turret lathes. These operations consist of turning both ends of the body and flanges and boring the ball cavity, ports, and sealing surfaces. Precise bores for anti-

Fig. 1. (Above) Stainless-steel bodies of two of the largest ball valves ever made for cryogenic service. They are part of a set of eight used in testing rocket engines for the interplanetary space vehicle Nova.

Fig. 2. (Right) Here, a milling operation is performed on one of the eight Nova test-stand valves. Ports, whose purpose is concerned with the retracting of the valve's dispersion-coated seats, were precision-bored in the same setup.

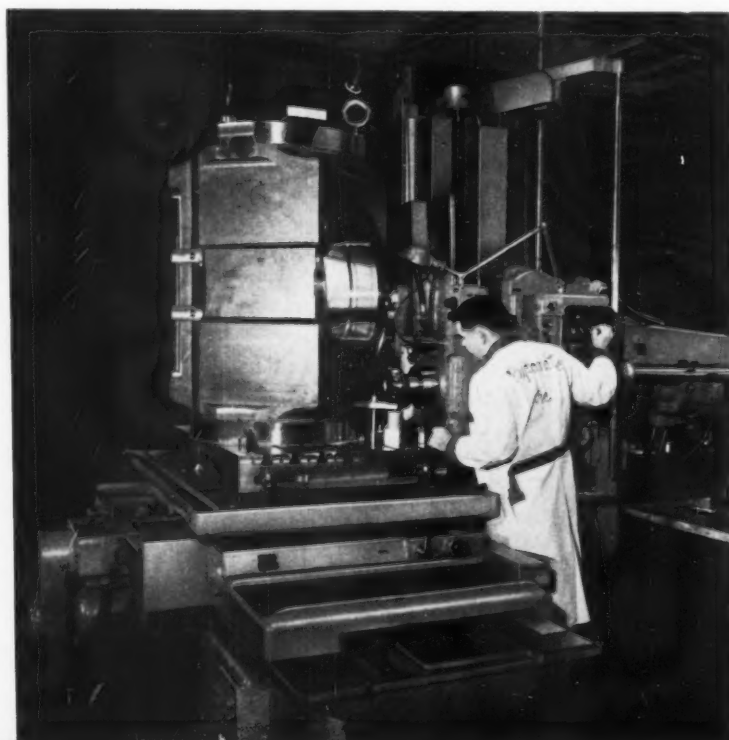
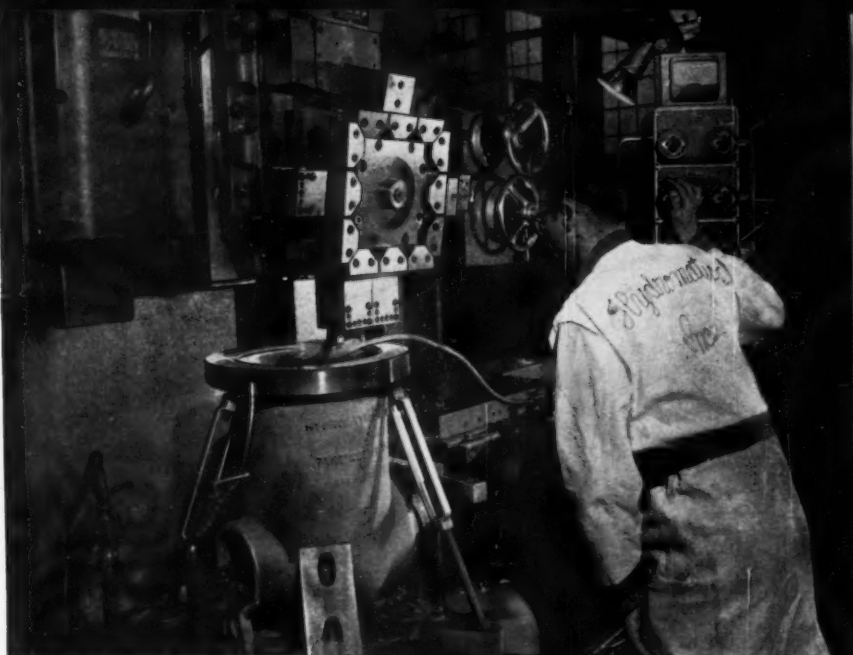


Fig. 3. Vertical turret lathes equipped for automatic cycling and used for commercial ball-valve production are seen here serving the company equally well in short-run machining of liquid-hydrogen valves for development of nuclear rocket-propulsion equipment.



friction bearings which support the rotatable ball members are also machined on this equipment.

In Fig. 3, a Bullard vertical turret lathe having a Man-Au-Trol attachment for automatic operation is shown being employed for turning a flange on a large valve body. This particular valve is designed for liquid-hydrogen service in connection with project Kiwi, which involves nuclear rocket-propulsion development. The Man-Au-Trol attachment allows the lathe to be readily converted from single-piece work to short- or long-run production. Manual operation may be



Fig. 4. (Left) Roughing of spherical surfaces below 2 1/2 inches in diameter is speeded by use of this special automatic-cycle machine. Fly-cutter head on vertical spindle is fed downward while part rotates on a horizontal axis.

Fig. 5. (Above) A typical rotating ball member as it appears after initial machining in automatic bar and chucking machines. Ends of ball section are chamfered to reduce spherical milling time to a minimum.

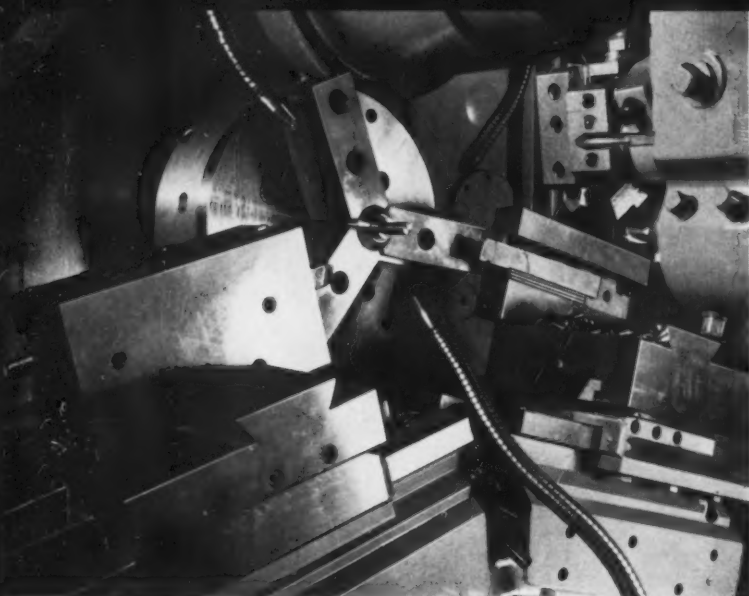


Fig. 6. Bodies and rotating members of ball valves undergo secondary operations in this automatic single-spindle chucking machine. Setup is for typical ball member (Fig. 5). Size repeatability of shell-molded castings used for many parts simplifies chucking operations.

used without disturbing an automatic-cycle setup for a long-run job. This versatility of operation is of particular advantage to the company in combining military work with long runs of commercial valves.

Valve bodies are machined from bar stock, forgings, or sand and shell-molded castings. Since parts cast by the latter process have a smooth surface finish and are more consistent in size,

Fig. 7. Surface finishes as smooth as 4 micro-inches are provided on ball valves such as those used in Pratt & Whitney Aircraft's XLR-115, the first liquid-hydrogen rocket engine. This engine has been chosen to power the Centaur space vehicle atop a modified Atlas missile.



Fig. 8. Flange holes and bonnet-mounting holes are drilled in this multiple-spindle drilling and tapping machine. A second head (not seen) is mounted opposite the one shown.

Fig. 9. This cam-controlled automatic-cycling lathe is used here to face and chamfer seating surfaces on small-size ball-valve bodies and fittings. The dual spindles can be set up to machine both sides of a single part.

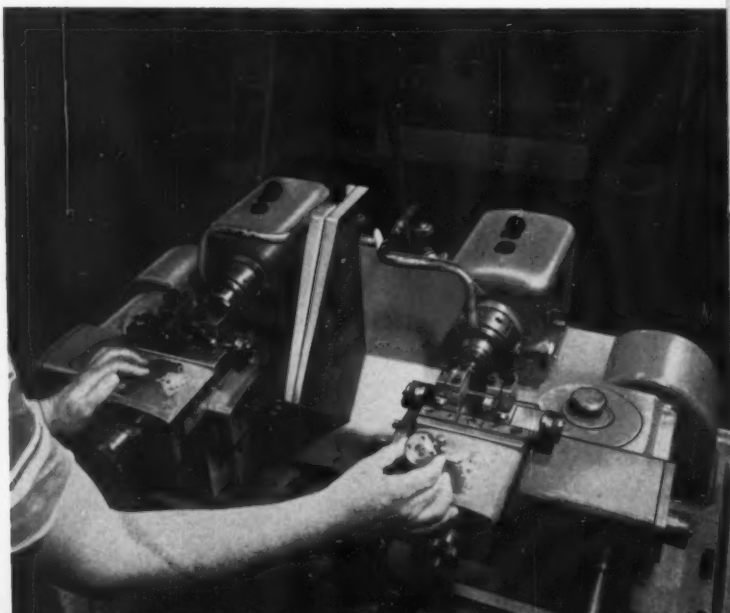




Fig. 10. Valve retainer plates are seen here being center-drilled, drilled, and tapped on a turret drilling machine having automatic-cycle operation. Aligning pin and master plate mounted on subassembly of the table allow rapid and accurate positioning of part.

they require fewer machining operations and are easier to chuck. Airborne cryogenic valves are made primarily of stainless steel and aluminum. In addition to these materials, many of the company's commercial valves are of mild steel, brass, and cast iron.

Spherical Contours Milled in Two Different Setups

The spherical contour of the ball members is generated in two different tooling arrangements. Roughing and finishing of large balls are both done on Kearney & Trecker horizontal milling machines equipped with specially designed heavy-duty fly-cutter heads employing carbide inserts. With this arrangement, the work-piece is rotated on a horizontal axis by an indexing head geared to the longitudinal feed-screw of the milling machine. The rotational axis of the ball intersects the axis of the cutter-spindle at an angle of 90 degrees. Positional adjustment of the fly cutters and the infeed of the machine table

determine the spherical diameter of the ball, which is held to tolerances as close as ± 0.0002 inch. The finish achieved on the balls in the setup is between 16 and 32 micro-inches.

Ball members below 2 1/2 inches in diameter are roughed out on the spherical surface in a special automatic-cycling machine developed by the Micromatic Hone Corporation. The tooling arrangement on this equipment (illustrated in Fig. 4) generates a sphere in essentially the same manner, but the fly-cutter head, which also has carbide inserts, is rotated on a vertical spindle. The head is fed down toward the work-piece, which turns slowly on a horizontal axis. The part is held in a collet on one end and supported by a center in the other. At the end of the machine cycle the collet releases the stub shaft of the ball (Fig. 5) and the operator simply rotates a handle (seen in the foreground of Fig. 4) to remove the completed part and insert the next one for the operation.

Cycle time on the machine is short; a ball of 2 1/2 inches in diameter can be rough-machined in about two minutes. Feed rates are adjusted by means of a hydraulic control valve. After roughing, the balls are finished to a 16- to 32-micro-inch surface in the same equipment.

Initial machining of the rotating ball members for the smaller-size commercial valves is generally done in automatic bar and chucking machines. The stock is first finish-machined on one end (chamfered, faced, bored, and cut off) in a bar machine and then sent to a Warner & Swasey single-spindle chucking machine (Fig. 6) for completion of the opposite end. Following the operations in the automatic chucking machine, the part is drilled radially through the large cylindrical section. A typical ball member is shown in Fig. 5 as it appears before drilling and the spherical milling operation. Both ends of the spherical section are chamfered in order to reduce the spherical milling time to a minimum. Bodies for many of the smaller commercial valves are produced from hexagon bar stock in a similar fashion. The larger sizes, however, are often cut from bar stock on a DoALL power cutoff machine, equipped with automatic stock feed, and completed on both ends in automatic chucking machines.

Ball-Valve Seating Surfaces Given Low Micro-Inch Finish

Following the spherical milling operation, the ball components are rough- and finish-lapped to obtain surfaces with roughness measuring down to about 4 micro-inches or lower. Many of the smaller balls which are not equipped with in-



Fig. 11. Liquid-oxygen valves are assembled with lint-free gloves in this pressurized clean room. Parts are ultrasonically cleaned and inspected for hydrocarbons which, if present even in minute amounts, can cause an explosion in presence of liquid oxygen.



tegral shafts are tumbled in quantity instead of being lapped. Some balls are rough-lapped and then tumbled.

Regardless of the procedure, it is important to obtain an extremely low micro-inch finish on both the ball and the seat. Teflon seats, for example, are machined to about a 5- to 8-micro-inch surface. Aluminum balls are lapped, anodized, and then relapped to insure the surface smoothness. This accuracy and finish is necessary in order for the company to produce cryogenic application valves such as those to be employed in the Pratt & Whitney Aircraft liquid-hydrogen rocket engine (Fig. 7).

The drilling and tappings of flanges and bonnet-mounting holes in bodies of 1- to 6-inch size valves are accomplished in a Baker multiple-spindle drilling and tapping machine. This equipment, partially seen in Fig. 8, has two opposed multiple-spindle heads and a rotary indexing fixture. The machine can be used to drill one flange as shown, and after indexing the part 180 degrees, drill the opposite flange. If holes are to be drilled and tapped, one head can be used for

Fig. 12. Checking for leakage of a ball-valve assembly for controlling a cryogenic fuel in a military test-stand application. Test instrument is a mass spectrometer.

drilling and the other head for tapping. In the illustration, the machine is set up for drilling four holes in both flanges of the valve body, shown about to be removed. A bushing plate guides the drills.

A Kummer double-spindle lathe (Fig. 9) with a cam-controlled automatic cycle is employed for operations on a number of small-size production parts. The machine can be set up to do one series of operations on one side of a part in one spindle and a second set of operations on the other side in the second spindle. Another arrangement possible is to set up both spindles to do the same operation and adjust the timing so that one spindle is being loaded while the other is going through the machining cycle. Two tool-holders are mounted on each tool-slide, with micrometer adjustment being available for each tool-holder



Fig. 13. (Above) This assembly of ball valves is the only control the pilot of the spacecraft X-15 has over his engine. They control the dual cryogenic propellants, liquid oxygen and liquid ammonia.

Fig. 14. (Top, Right) Assembly of valves for the liquid-hydrogen rocket engine seen in Fig. 7. Invar spacers compensate for the differential in thermal expansion of the bolts and valve retainer plates.

Fig. 15. (Right) Spent-uranium ball machined for safe handling of fuel elements at the Enrico Fermi reactor. The fumes are toxic and the chips easily ignited.

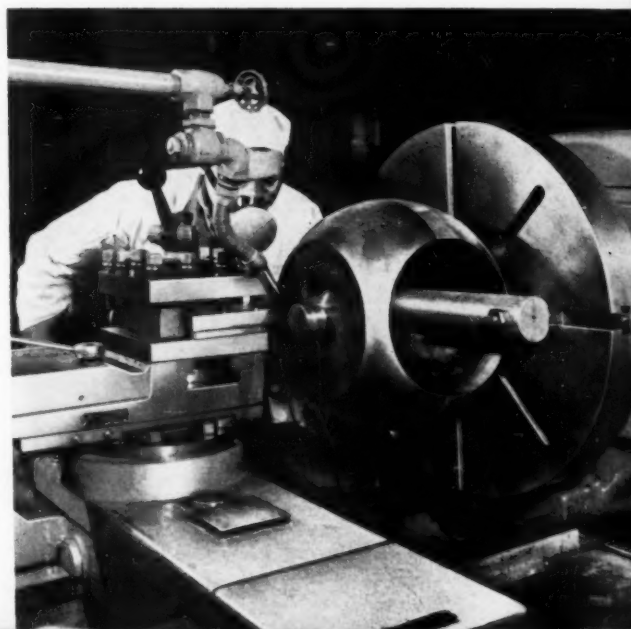


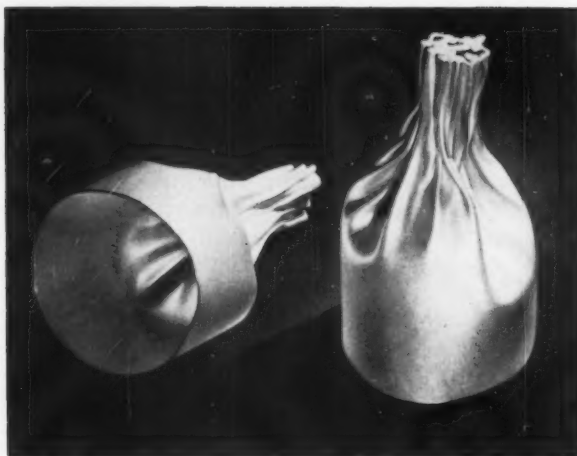
and slide. The work is held in pedal-operated collets. This equipment is capable of machining parts up to 2 1/2 inches in diameter.

In Fig. 9, the machine is set up to do similar operations on one side of two different brass parts—a valve body and an end fitting for a valve body. The right-hand tool, which is inverted, chamfers the outer edge of the end seating surface and rough-faces the seating surface. When the first tool cycle is finished, the left-hand tool finishes the same seating surface and chamfers the inner edge of the bore. A 16-micro-inch finish is attained.

Drill-press operations on valve retainer plates and other similar components are performed in the Brown & Sharpe automatic turret drilling machine seen in Fig. 10. Capable of up to six different operations in one automatic cycle, this machine is made convenient to operate and set up for long runs by means of work-positioning ta-

(Continued on page 128)





Metal-forming with Electromagnetics

MAN HAS STUDIED, experimented with, and used electromagnetic effects for years. His ability to produce and control such forces has provided technology for whole industries. Items such as motors, generators, and transformers are possible due to applications of electromagnetics. Television sets in our homes depend on these effects to function.

Probably the newest application of these forces is in metalworking. Convair, for the past several years, has investigated potential applications along these lines. At present, fittings are secured to tubing by electromagnetic swaging, both internally and externally. Such work is carried out on a production basis.

In these swaging operations conductive metal parts are placed in a coil in such a manner that they are flux-linked with the coil. The workpieces can be considered as short-circuited, secondary coils. This means that the primary work-coil current will be a maximum due to the short-circuited secondary. Changing the primary flux

Extensive research has demonstrated the capabilities of electromagnetic forces in swaging, blanking, and forming sheet metal

A. P. LANGLOIS, Supervisor
Applied Manufacturing Research
Convair, a division of General Dynamics Corporation
San Diego, Calif.

induces a counterpotential in the work-piece. This gives rise to current flow and flux fields that are in opposition to the primary flux. Consequently, when electrical energy is applied to the work-coil, the net resultant magnetizing force is applied equally to the work-piece and coil. If this energy exceeds the elastic limit of the work-piece, permanent deformation takes place. The effects of electromagnetizing forces applied to an aluminum tube are indicated in the heading illustration.

The first work-coils were solid copper, as seen at the left in Fig. 1. In the operation here illustrated, a hexagonal-head machine screw was used as a mandrel. At the lower right is seen a sample of formed work that has been cut through along the horizontal axis.

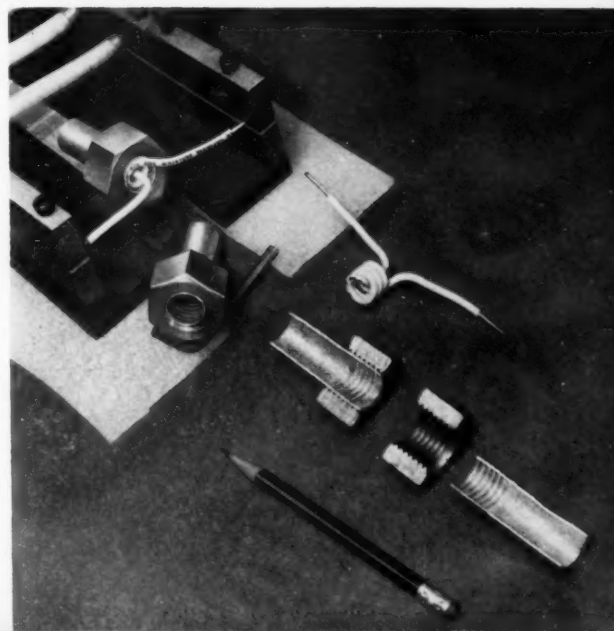
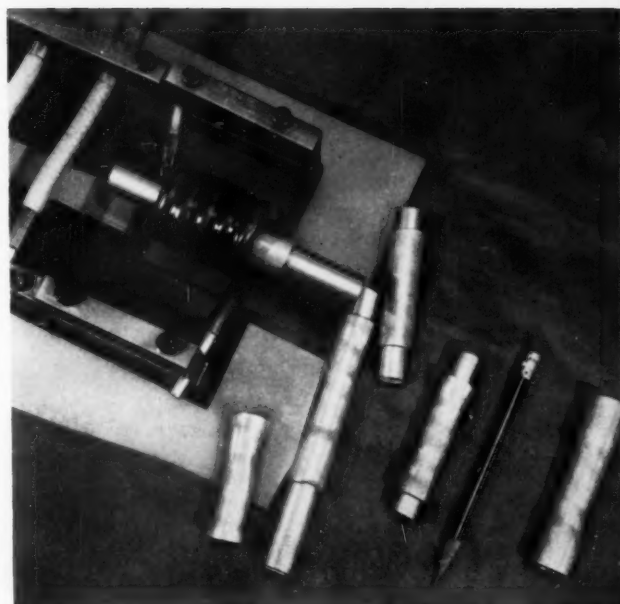
In Fig. 2 is shown a piece of aluminum tubing being swaged on stainless-steel tubing. Fig. 3 shows an example of tube expansion which is the effect of using an insulated-wire, hand-wound coil inside of the work. The latter is inserted into a large nut mounted on the electromagnetizing fixture.

A setup employed in swaging end fittings to coaxial cable on a production basis by the application of electromagnetic forces is illustrated in Fig. 4. One advantage of this technique is that no compression wrinkles occur in the sleeves that

Fig. 1. (Top) One of the early copper coils designed for the swaging of aluminum tubing on mandrels of various types.

Fig. 2. (Center) An operation in which tubes of aluminum are swaged on stainless-steel tubes, the coil being the same as that in Fig. 1.

Fig. 3. (Bottom) An operation in which an electromagnetic coil is inserted inside of tubing to expand it.



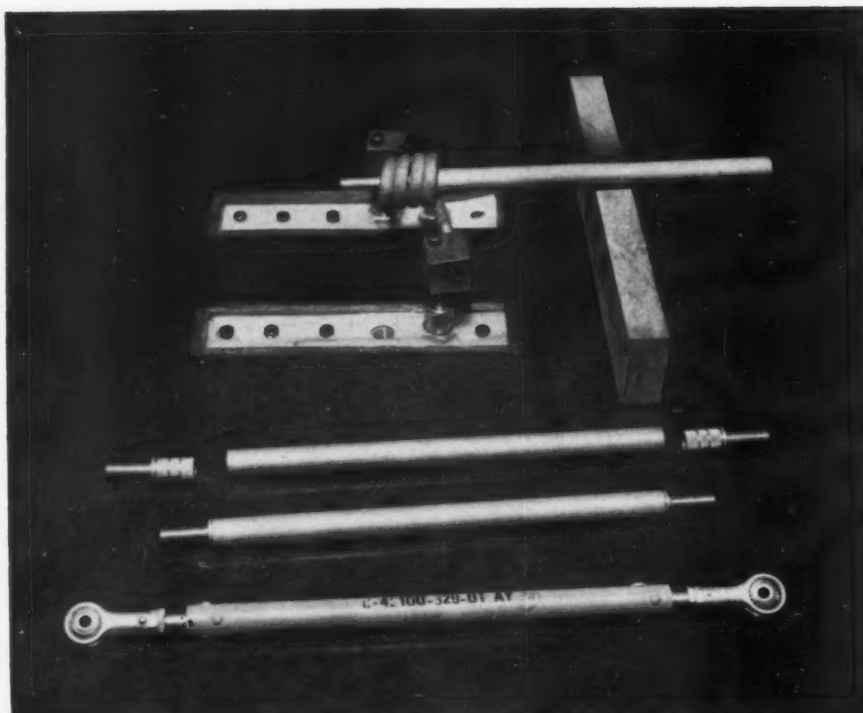
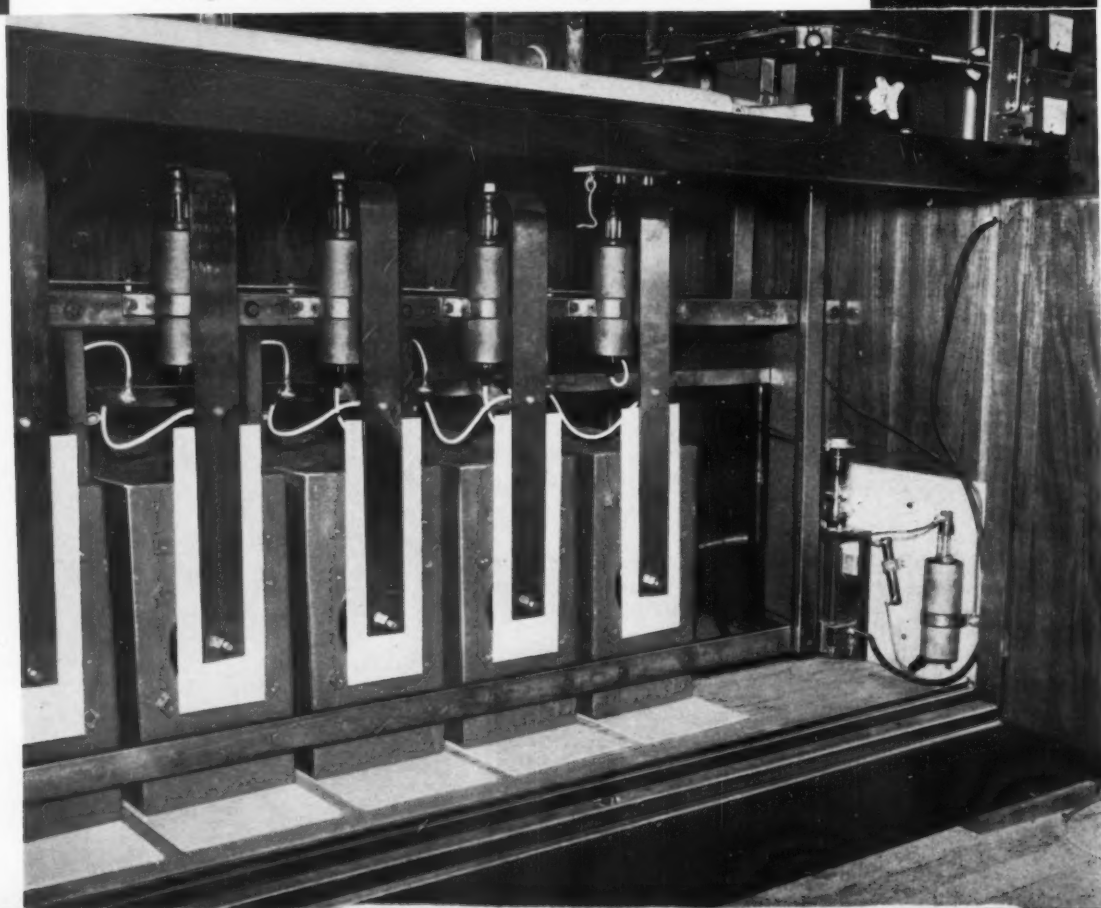


Fig. 4. Aircraft control rods are being assembled on a production basis by applying electromagnetic forces for swaging.

Fig. 5. Bank of capacitors arranged in a demonstration unit for storing a considerable amount of electromagnetic energy.



are joined to each other and to the cable parts.

A dielectric circuit is ideally suited for use in metal-forming. In this type of circuit, the storage capacity for electrical energy and the transient discharge of the stored electrical energy supply the initiating magnetic field in and around the work-coil. Several capacitors connected in parallel comprise a bank of energy for the Convair operations. This energy-storage bank is illustrated in Fig. 5.

A high-voltage switching circuit is used to discharge the stored energy. Ignitron tubes are in series with each capacitor to switch the charge into the work-coil. A separate high-vacuum, high-voltage switch is used to trigger the ignitrons. The discharge of the storage bank of capacitors follows one of three possible wave shapes, depending only on the discharge circuit parameters, resistance, inductance, and capacitance.

Convair coil design has taken two paths. In one case a permanent type coil has been developed that is a completely machined helix of copper. The helical turns are insulated with epoxy and fiberglass, and baked. The entire assembly is pre-stressed under compression with heavy end plates that are drawn together by means of steel bolts. This construction counteracts intense forces that act on the coil through electrical discharge. Fig. 6 illustrates one of the latest coils to be designed along the ideas mentioned. The end plates are made of 1-inch thick Micarta which are backed up by 3/8-inch thick aluminum plates. Eight bolts 3/8 inch in diameter hold the assembly together.

An expendable type of coil has also been developed for the swaging of aircraft parts by the electromagnetic process. Fig. 7 shows such a coil mounted on a part prior to swaging. This coil is composed of a few turns of plastic-insulated copper wire. The coil is wound on a mandrel having the same outside diameter as the work-piece and then is slipped over the work, as shown. The cost of such a coil is only 2 or 3 cents, in comparison with several hundred dollars for permanent coils.

At the time of magnetic discharge, when using expendable coils, it is necessary to provide a guard against flying pieces of copper debris. Fig. 8 shows the production unit with a safety box in place that protects the operator from flying copper pieces. Access doors of this unit were raised at the time that the photograph was taken so as to expose the working area. In swaging with

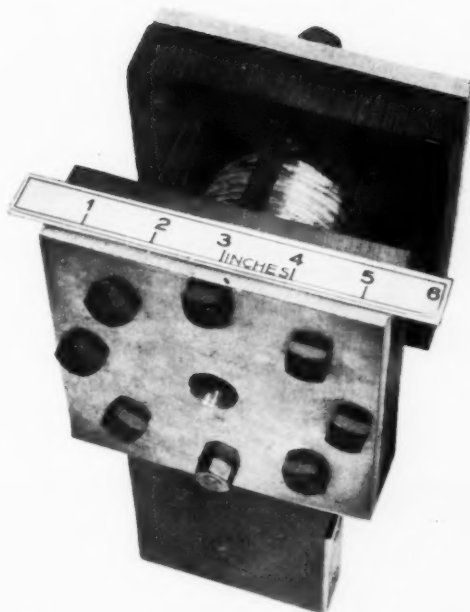


Fig. 6. Permanent type coil of present-day design which is used in swaging operations on a variety of parts.

an expendable coil, the operation, of course, takes place before the force reaction destroys the coil.

An evaluation program was followed that established process variables such as voltage range, type of coil, number of coil turns, and preprocessing treatment data for swaging end fittings in control rods and torque tubes. These parts are typical of linkage used for aircraft control surfaces. In addition to control rods, other examples of swaged parts are shown in Fig. 9. For instance, one end of an escape rope, made of cotton, which requires a terminal end sleeve swaged to it is illustrated at the right. The connector strength exceeded the ultimate strength of the rope.

Although this article has thus far discussed swaging only, equally interesting work has been conducted in the area of blanking, forming, embossing, and drawing sheet metals. The same basic approach has been used and power sources are identical. However, the work-coil is necessarily different. Flat spiral coils are being experimented with. The results are fairly well fixed for aluminum and aluminum alloys. Fig. 10 shows such a flat coil in a fixture ready for use. At the lower left is a die of the type that is used for

Fig. 7. (Right) Use of an expendable coil is most economical because such coils only cost a few cents each.

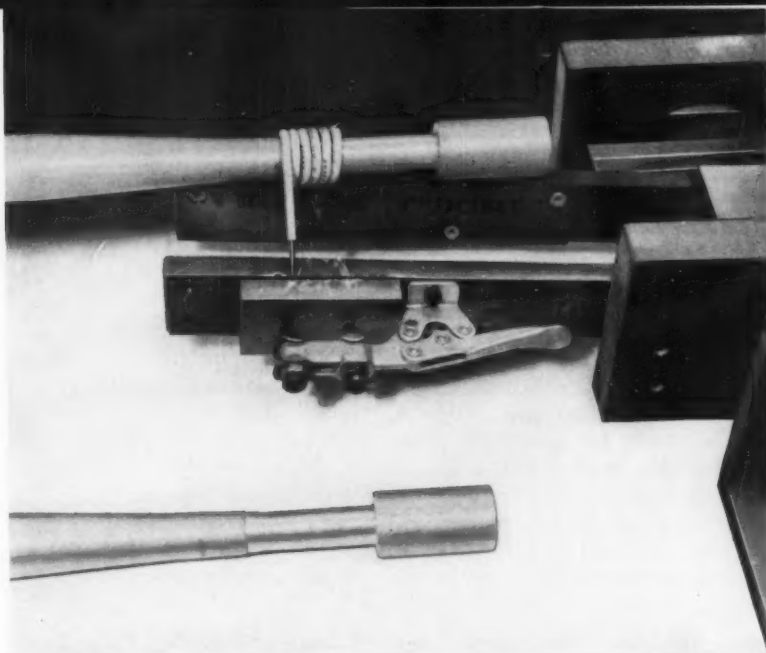


Fig. 8. (Below) General view of production equipment which has been designed with guards to protect the operator from flying pieces of copper as expendable coils disintegrate.

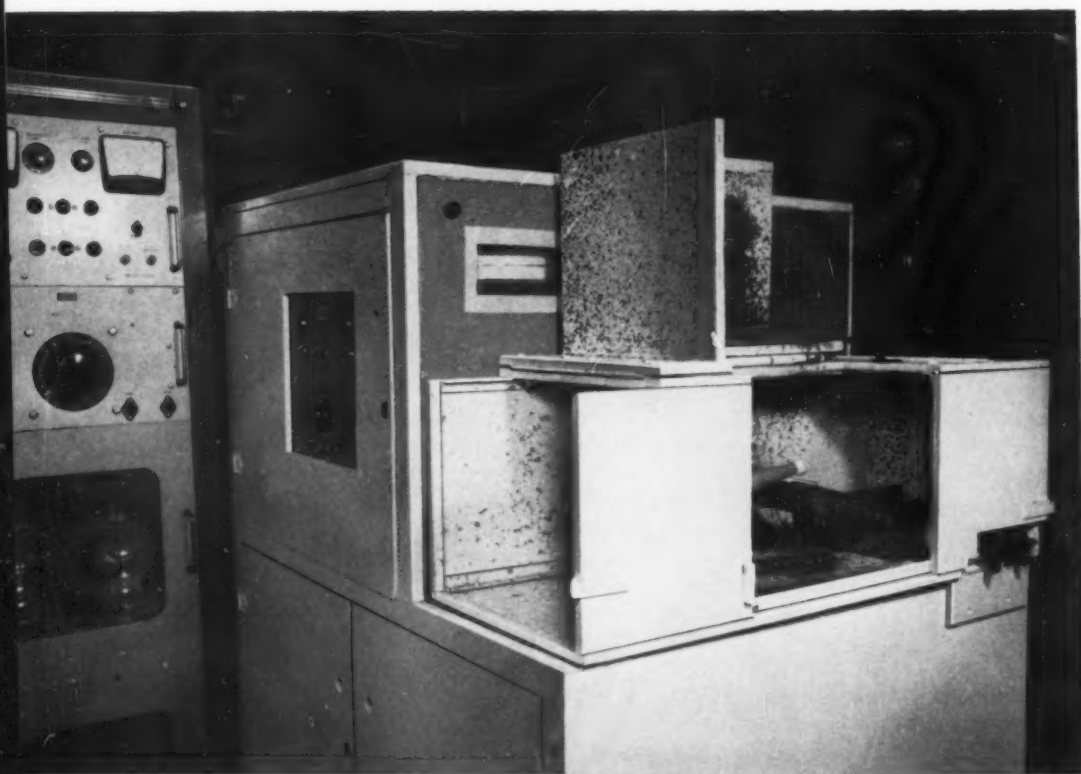




Fig. 9. (Above) Variety of parts which have been formed and assembled by the application of magnetic forces.

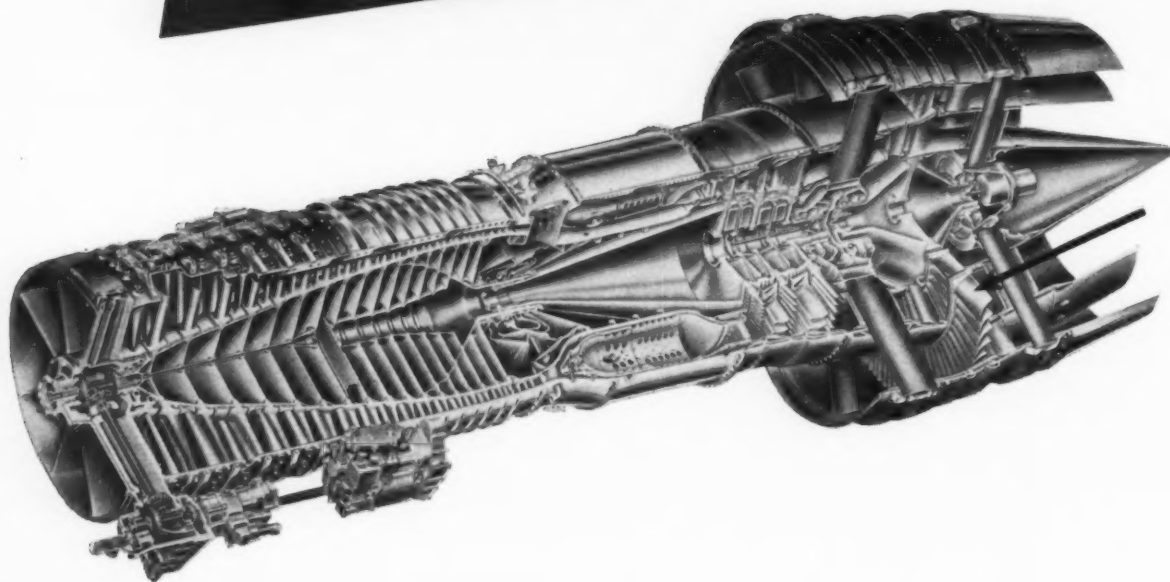
Fig. 10. (Right) Flat type of coil used in operations such as the embossing of disc-like parts.

forming and embossing operations. It is equipped with a flat coil for forming flat stock.

The sphere for electromagnetic applications in the over-all high-energy-rate forming field is at present limited to small parts. Dimensionally the maximum limit is 12 inches in diameter for a blank to be formed, and up to 0.125 inch in thickness. In the final analysis, electromagnetic forming capability depends upon the energy-storage capacity and the ability to utilize that energy efficiently for useful work.



BLUCKETS **for Aft-Fan Jet Engines** **Plasma-Metalized**



PUT General Electric CJ-805-23 jet-fan engines in a Convair 990 and, according to the advertisements, the vehicle becomes an "Astro-Jet, the second stage in jet transportation." It is true that this type of jet engine delivers more thrust; consequently, it increases the speed and efficiency of the aircraft.

The heading illustration is an air-brush artist's rendition of an aft-turbofan engine that will deliver 16,100 pounds of take-off thrust.

As can be seen on the left side of the picture, the front end of the aft-fan engine strongly resembles jet power plants that have been familiar for a decade or more. The fan part of the engine (which is different) comes at the extreme rear. Notice that there is an extra shell or outside case around the turbine. A close examination (see arrow) shows that the last stage of the turbine is unusual. First, this is an extra stage, or row, of buckets. Second, these rear turbine buckets, instead of ending at the normal case, bulge out-

ward into a "platform," and then continue in a changed airfoil contour to the outer case as blades of the fan.

These blades are called bluckets by designers and other personnel at General Electric's Flight Propulsion Division, Evendale, Ohio, because they combine the blade and bucket functions.

The significance of this unusual new design is that the blade portions, extending into the plane's slip stream, pick up extra power as the air passes around them at the 600-mile-per-hour cruising speed of the airplane. The fifty-four bluckets in this stage of the turbine turn in a continuous slot through the main wall of the turbine. The platforms of the individual bluckets interlock when assembled. Fore and aft faces of the platforms are machined with annular grooves to form seals (B, Fig. 3) with the shell. The closures are 98 per cent effective as far as thrust leakage is concerned. Installation of the fan changes none of the operating characteristics of

If the reader did a double-take at the word "bucket" it is not a misprint, but the name of the fifty-four blades making up the final turbine stage of General Electric's jet-fan engines, now beginning to drive luxury airliners. The bucket stage combines the function of blades and buckets. Plasma-flame sprayed coatings contribute importantly toward increasing the service life and reliability of these critical components of the jet

LAURENCE W. COLLINS, JR.

Associate Editor

MACHINERY, July, 1961

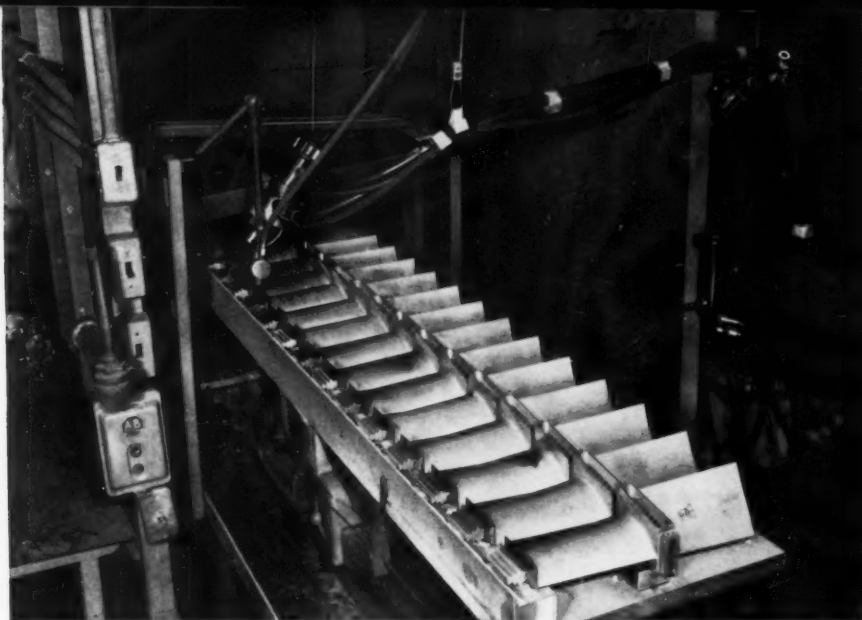


Fig. 1. Bucket-holding fixture carries parts beneath plasma gun. Metal-powder feeding device is at right.

the basic jet engine. Thus, this engine delivers more power and speed with the same amount of fuel as earlier models. The need for noise suppressors is not present on this design of engine.

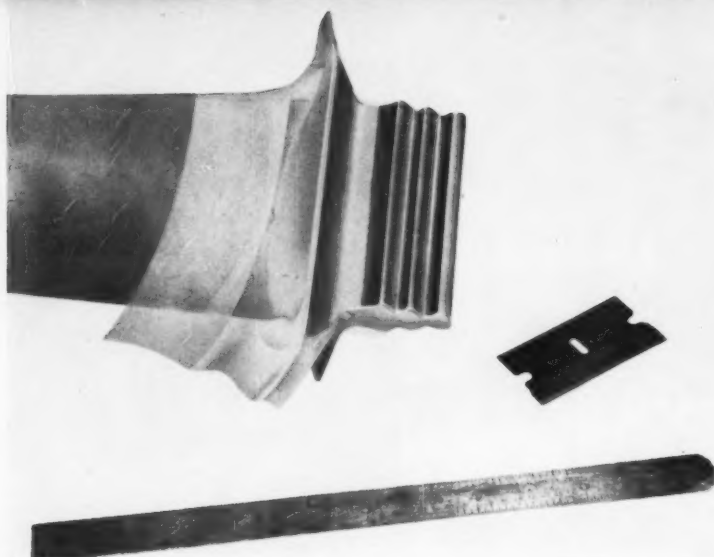
However, this aft portion of any jet is a hot spot during operation. Because the case of the jet is cut through to permit extension of the buckets, the aft end of the turbine shaft must be supported by the outer case.

Obviously, inasmuch as all design improvements have their cost, the bucket brought a few problems of its own. For example, under the sustained heat and pressure of jet exhaust, even "superalloys" gall and seize unless their surfaces are properly protected.

Galling and seizing of ordinary hot-stage turbine buckets takes place at the dovetail, or "Christmas tree." However, a bucket, because of its novel design, may also gall at the platform female-interlock pressure faces, which have mating torque-and-groove fits for added stability. Another possible problem area is that of wear and erosion on the platform front and back seal-groove faces that make the rotary closure with the turbine case. The buckets are made from an alloy designated V-57, which is a modification of A-286, a superalloy.

To help eliminate galling and seizing at the dovetails it had been the practice at General Electric to plate the trouble areas with rhodium. However, tests with the aft-fan engines showed that the life of rhodium-plated buckets was limited to between 100 and 200 hours—nowhere near the required 1000 hours. On the other hand, to produce a reliable, wear-resistant coating for the case-to-platform seal areas was a totally new ef-

BUCKETS



fort. A soft coating was needed to solve the first problem and a hard coat for the second.

A pilot line (Fig. 1) was developed in the metallurgical section of the company's manufacturing engineering laboratories to test plasma metalizing as a means of depositing both soft and hard types of coating. The characteristics of adhesion, thickness control, and uniformity of the bucket coating could be checked in detail.

The procedure is a simple one. The parts are masked, for selective blast cleaning, with a double thickness of pressure-sensitive tape. Areas to be plasma-flame sprayed are stripped, using a razor blade to trim the tape from the areas to be coated, Figs. 2 and 3. The buckets are then grit-blasted, the masks are next stripped off, and all exposed areas are wiped clean with acetone. Within two hours they must be metalized by

Fig. 3. Platform interlock pressure area (A) of bucket is exposed through the mask for grit blast prior to flame plating. Seal grooves (B) are hard-faced by plasma spray.

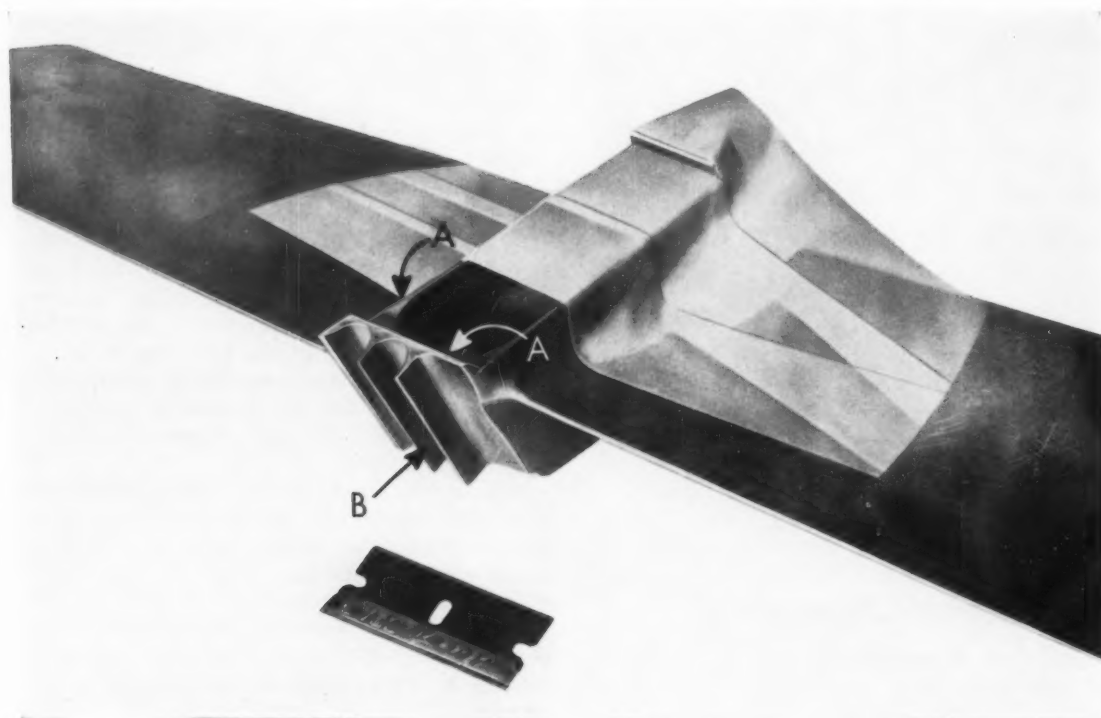
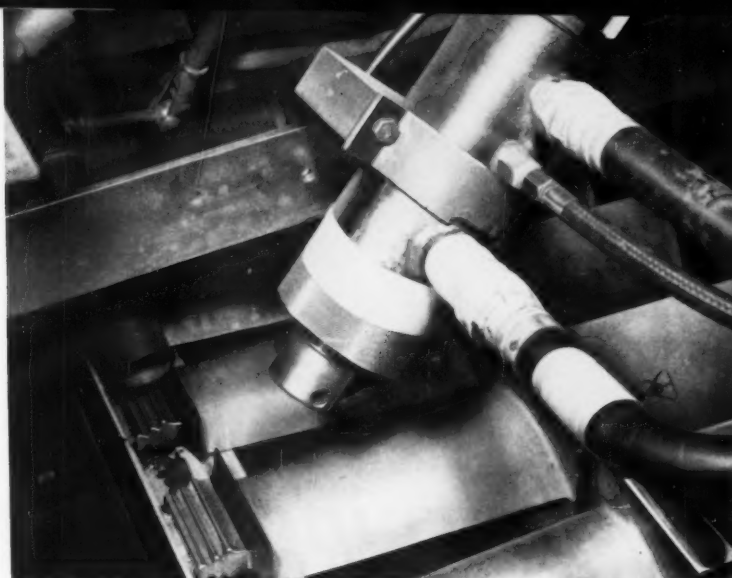


Fig. 2. (Left, facing page) Root of the bucket is masked with pressure-sensitive tape so that coating will adhere to the dovetail only.

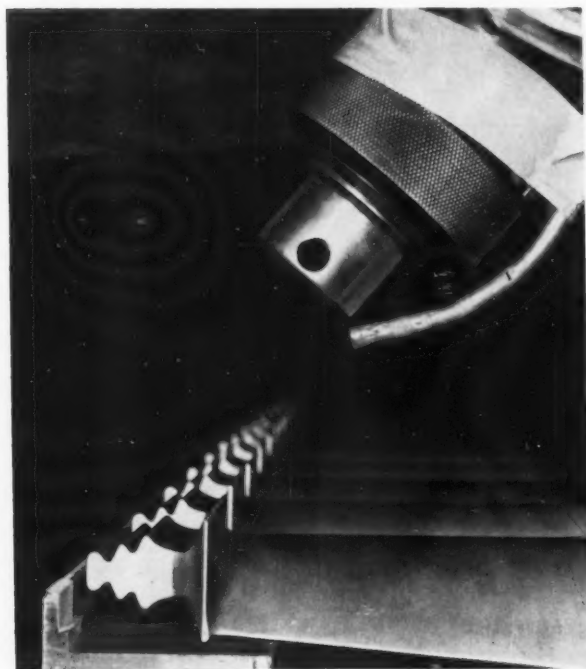
Fig. 4. Close-up of plasma-flame spray setup shows tight positioning of the gun.



plasma-flame spray, Fig. 1, to precede surface oxidation. Because the buckets are to be manufactured in volume by a subcontractor, a moving rack was built under the plasma gun for testing and optimizing traverse rates. The rack holds twenty buckets, and the rate of travel past the gun muzzle can be varied to control the depth of coating, Fig. 4. A few seconds' exposure was found adequate to deposit a 0.003- to 0.005-inch depth of soft- or hard-face coating.

The Metco T-3 plasma gun is held at a distance of 3 inches from the work (half the usual plasma

Fig. 5. Plasma metalizing of turbine-bucket dovetails extends life to at least 1000 operational hours.



space), Fig. 5. The gun is cooled by circulating deionized water to minimize the formation of hard-water scale.

The plasma gun is powered by four Airco 200-ampere welding generators wired in series parallel to deliver 400 amperes. On the side of the booth, Fig. 1, is a small dispenser for the coating material, which is introduced in the form of powdered metal. The powder mixture in the container is kept in a state of agitation by an electric vibrator and is delivered suspended by a gaseous mixture which is 90 per cent nitrogen and 10 per cent hydrogen. The entrained powder-and-gas mixture is metered into the plasma blast near its orifice at a predetermined flow rate.

Within the gun's chamber an arc is struck in an atmosphere also 90 per cent nitrogen and 10 per cent hydrogen. A reaction of the gas mixture takes place in the high energy of the arc, causing expansion in excess of Mach I. The violence of the reaction knocks a few electrons out of their normal structural lattices, making them ionize with a corresponding release of energy and rise in temperature. Temperatures up to 30,000 degrees F. are attainable.

Control of the plasma setup is housed in a console built by Thermal Dynamics Corporation, Lebanon, N. H., which affords the operator with complete means of varying the electric power of the plasma arc. Also, a variety of gases supplied to the gun can be metered and controlled as to volume pressure and mixture. Depending on the powder alloys or base material to be sprayed, the plasma envelope atmosphere may be varied to include argon, helium, or other gases. Therefore the console also provides for switching, metering, proportioning pressure, and mixing the gases.

The metalized coatings adhere only to the areas that were grit-blasted.

Forging progress anticipates space demands

HAROLD W. BREDIN
Associate Editor

WITH the race to conquer space on in earnest, optimum metallurgical properties are now being attained in complex "superalloy" and "exotic" metal forgings to fulfill functional criteria crucial to advanced missile and space-vehicle designs. In production are huge closed-die forgings that offer maximum usable strength-to-weight ratios or can satisfy heavy-duty applications at temperatures in excess of 1800 degrees F. Further improvements in metal-forging capability, coatings, lubricants, and dies are currently being developed.

The ever-increasing need for engineering materials with more advanced properties has fostered research to extend the practical use of forging to new metals. As a result of these studies, Wyman-Gordon Co., Worcester, Mass., is now successfully forging materials such as Astroloy, Rene 41, Waspaloy, Udimet 500, titanium, beryllium, molybdenum, columbium, and tantalum. In addition, techniques for forging tungsten are under development. Typical uses of forgings in missiles and re-entry vehicles are shown in Fig. 1.

Shields for manned vehicles re-entering the earth's atmosphere, rocket propulsion components, as well as parts for the more conventional jet engines must withstand extremely high tem-

peratures while maintaining design-stress capability. Depending on the temperatures involved, parts for these applications are forged from three classes of materials: (1) the medium-high-temperature alloys, such as INCO 901, V57, and A286; (2) the nickel-base superalloys (Astroloy, Rene 41, Waspaloy, and others); and (3) the refractory metals—molybdenum, columbium, or possibly tantalum.

Parts made of the medium-high-temperature alloys are being forged on a production basis for service in the 1000- to 1200-degree F. range. When the service temperature exceeds 1200 degrees F., but is below 1800 degrees F., the nickel-base superalloys are applicable. Service at temperatures above 1800 degrees F. requires use of the refractory metals. Experience in forging the refractory metals, however, is limited, and although there are applications now, there are still many fundamental processing problems to be solved. Primary application temperature range for forgings of the various metals and an indication of the present state of the art in their processing is given in Fig. 2.

Closed-die forgings of the iron- and nickel-base alloys for high service-temperature applications (above 1000 degrees F.) are made with the work-piece heated to temperatures in the 1600-



to 2100-degree F. range. Furnaces used to heat the stock at the company are either of the large conveyor type or of the rotary-hearth type shown in Fig. 3. Standard tool-steel dies, preheated to about 600 degrees F., are employed for these alloys as well as for the refractory metals. At these forging temperatures, parts made of iron- and nickel-base alloys are shaped (either in presses or hammers) and removed from the dies before any damage can occur to them.

In the heading illustration a part is being placed in closed dies in the huge 50,000-ton forging press at the Grafton, Mass., plant owned by the United States Air Force and operated by the Wyman-Gordon Co. The press shown is one of two of this size built under the Air Force Heavy Press Program. They are believed to be the largest in existence.

Of course, the superalloys and refractories have greater strength at the higher forging temperatures and are, therefore, a lot harder to shape in a plastic condition. Because these materials are stronger and tend to be more brittle and tougher than steels, they unquestionably wear the dies more rapidly. Die wear is greatest with

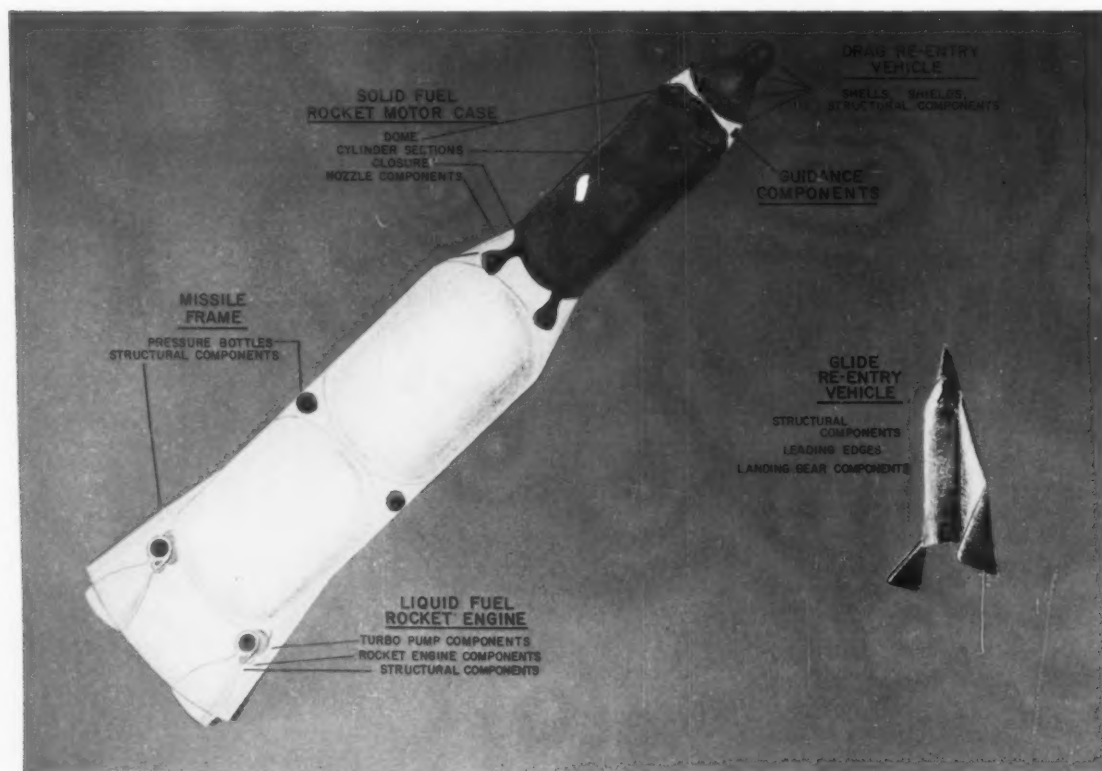
the refractory metals, some of which are now being forged experimentally at temperatures in excess of 2500 degrees F. Although methods of improving dies are under study, the problem is not serious at this time, since there are not enough forgings being produced of the refractory metals to make die wear significant. Dies used for iron- and nickel-base alloy forgings do not normally show what can be termed an excessive amount of wear.

Contour machining of a closed forging die in a vertical boring mill operated under tracer control is illustrated in Fig. 4. When completed, the die set of which this is a member weighed 70 tons and was used in the 50,000-ton press to forge nose cones for missiles. Die-blocks of this size are heated prior to forging in a car type furnace such as the one shown in Fig. 5.

Various Vacuum-Melting Methods Are Used

At present many of the parts being forged for high-temperature service are discs or wheels having cross sections of various contours. They are employed in jet aircraft and rocket engines as

Fig. 1. Forging, as in the past, is providing components for the most critical applications. Here illustrated are typical uses in missiles and space vehicles.



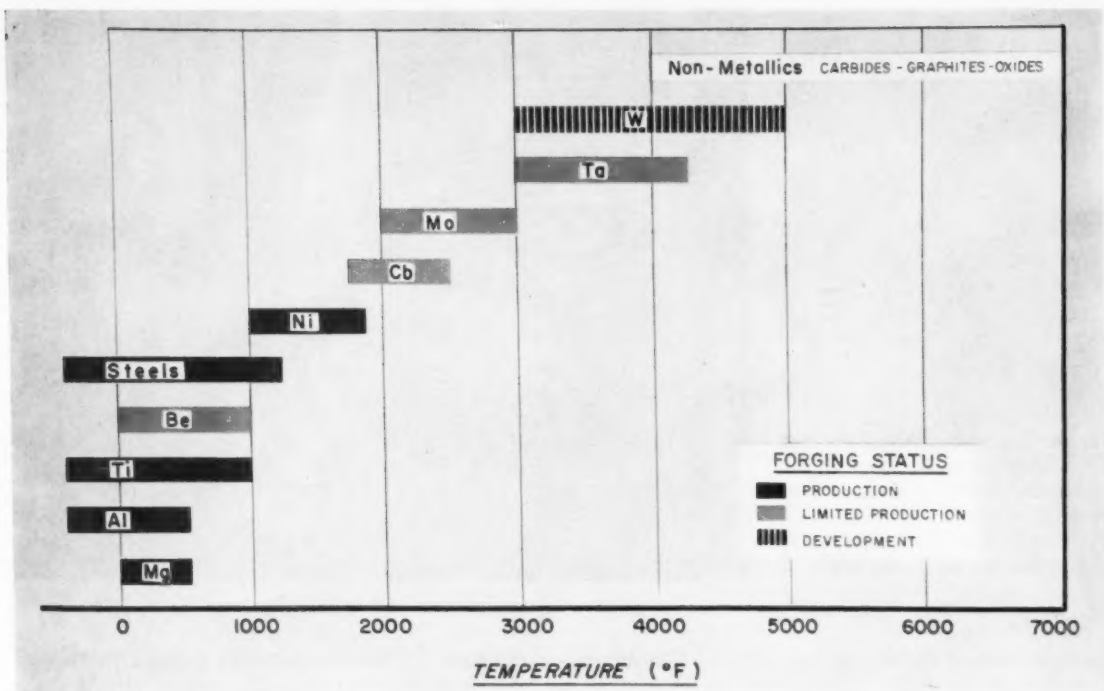


Fig. 2. Chart showing the temperature ranges at which forgings of various metals normally would be placed in service. Extent to which each metal is being forged is also indicated.

Fig. 3. Rotary-hearth furnace for heating stock prior to forging. Thirty feet in diameter, this unit is equipped with instruments that maintain work-piece temperature within precise limits.

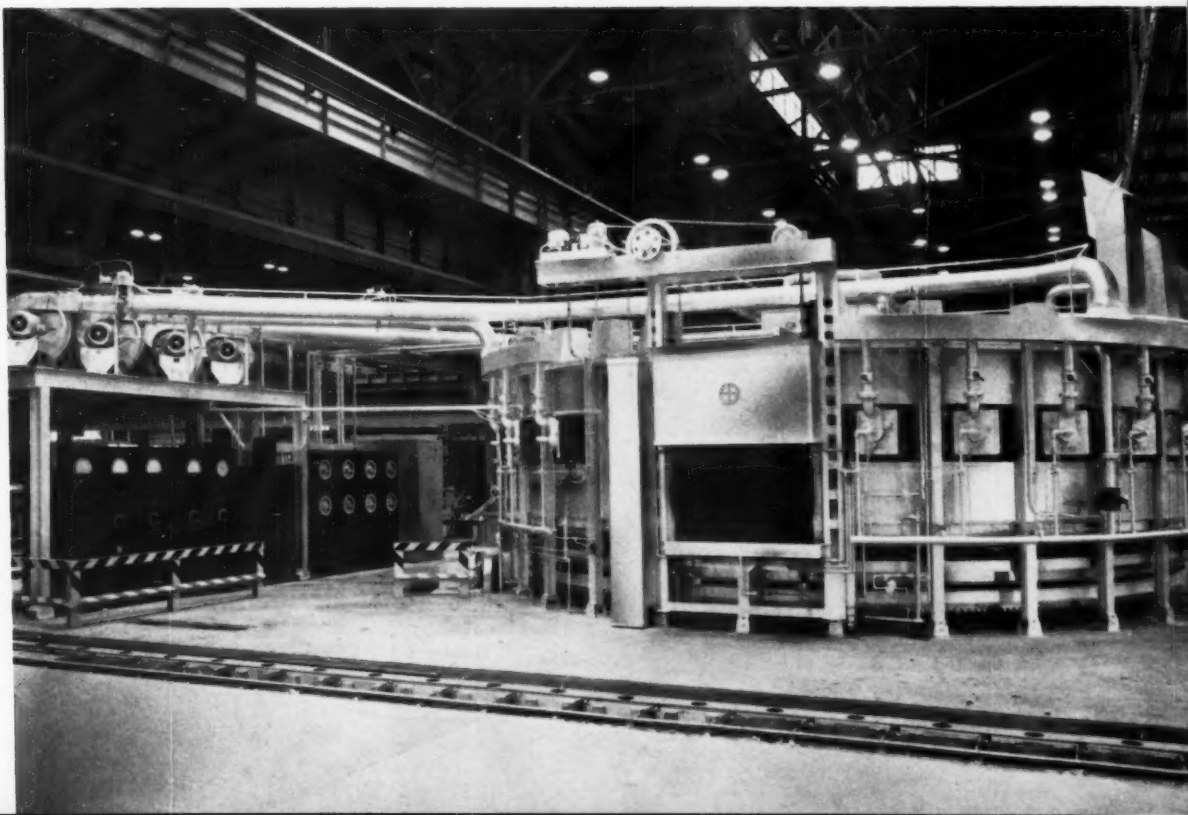
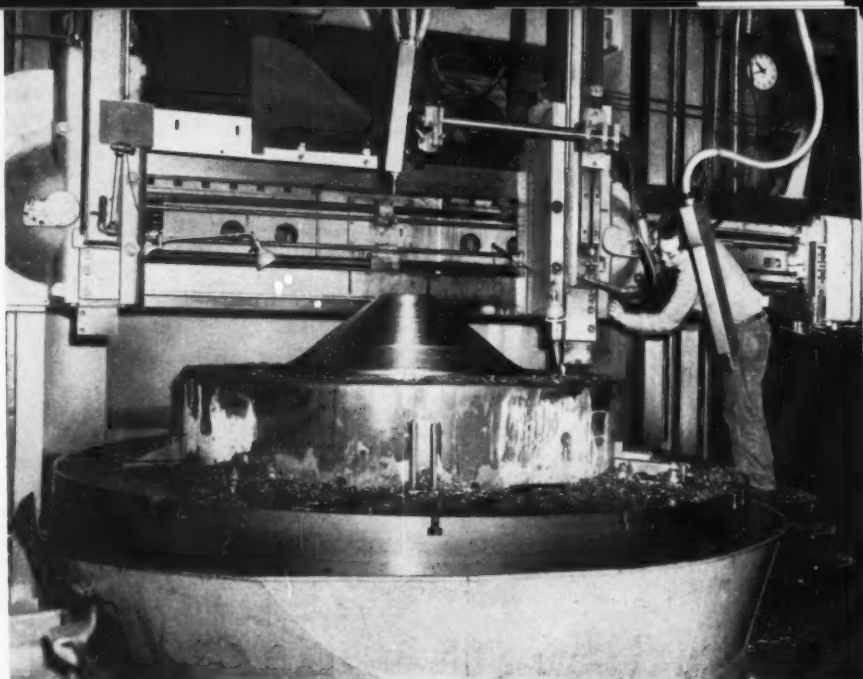


Fig. 4. Tracer-controlled contour machining of a die member for closed-die forging of a missile nose cone. Completed die set, which weighed 70 tons, was employed in the 50,000-ton press seen in Fig. 3.



turbine wheels or compressor rotors. To obtain satisfactory forgings, careful control of processing must start back when the metal is melted. Most of these metals are melted in vacuum by one of several different methods and cast into an ingot. For example: whereas induction vacuum-melting techniques have been developed for the nickel-base superalloys, ingots of columbium are produced by vacuum consumable-electrode melting of electron-beam melted metal.

Since the nickel-base superalloys are extremely complex, they have to be melted very carefully and then handled in such a manner as to prevent contamination before being cast. In addition,

these alloys generally have to be cast in special molds in order to minimize segregation of their various phases.

Once cast, ingots are cogged (drawn on cogging presses) or bloomed in what is simply a rolling mill. These processes reduce the ingots in cross-sectional size and prepare them into billet lengths, the form in which the metal is received at the forging plant.

Billets are generally sonically inspected, and slices taken from various sections are etched and checked with a microscope for phase segregation, exogenous inclusions, or other faults. Chemical composition, engineering properties, and forging

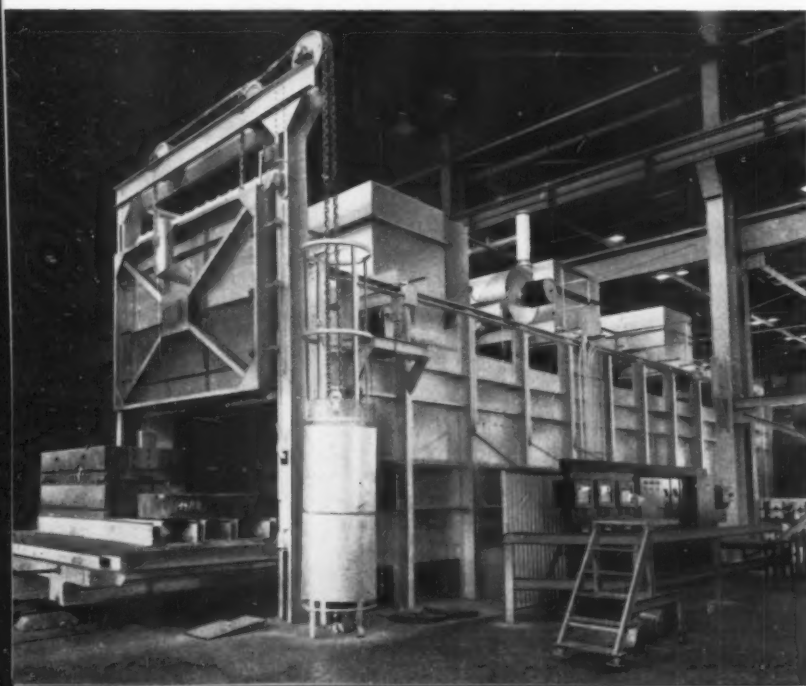


Fig. 5. To facilitate handling, huge closed-die blocks are heated to temperatures up to about 600 degrees F. in this car type furnace prior to forging.



Fig. 6. Direct-reading spectrograph for analyzing the chemical composition of forging materials. Results are dependable and quickly obtained.

capability are also determined at this time. Samples of a billet or particular heat are forged and tested to make certain that the metal can be properly worked before it is ever started through the production cycle. Then, during various stages of the cycle, the material again may be sonically inspected, etched, or checked with a dye penetrant to pick out any defects which may have occurred in the piece during forging. A direct-reading spectrograph (Fig. 6) is the most popular method of determining chemical composition, since it is both rapid and dependable. Inclusions or discontinuities present in a billet disqualify that particular portion of the stock for use, since the majority of discontinuities do not heal properly in forging.

At this point, product engineers decide how much metal is required to forge a particular part, figuring certain losses. Their calculations, based mainly on experience, determine how much material is needed to fill the closed dies, protect the part, and obtain the optimum properties. A typical turbine-wheel forging might require a 300-pound billet.

In forging, the billet would first be placed on flat dies and upset into what is essentially a pancake shape. Following this stage, the work-piece is processed in closed dies. Turbine wheels may go through operations in as many as four different closed dies, depending on the complexity of the part. General nomenclature for forging operations when four closed dies are employed are preblock, block, prefinish, and finish, each die in order being used to produce a more closely defined contour.

Simple forgings, of course, do not need to go

through all of these steps but may be processed directly in a finishing die. Most wheel contours, however, require some blocking and a prefinishing operation. In Fig. 7, a refractory-metal work-piece, made of columbium alloyed with 1 per cent of zirconium, is shown after it has passed through closed blocking dies and is ready for the finishing operations.

Another engineering task is to fit the operation to a forging press or hammer. Smaller turbine wheels, for example, are done on hammers because they generally have sufficient power to do the job. When large-diameter wheels are to be forged, greater pressures than the hammers can deliver are needed and heavy press equipment

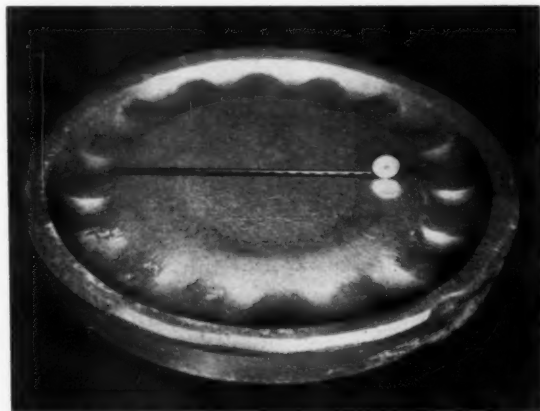


Fig. 7. Closed dies formed this refractory-metal blocker shape from a "pancake." Completion of the forging is subsequently accomplished in finishing dies.



Fig. 8. Ring-rolling machine forging a 40-inch ring for a jet aircraft engine.
Rollers apply forging pressure as they rotate and shape the heated part.

Fig. 10. This ring is one of two cut from a composite wheel type forging of Rene 41, a nickel-base superalloy. On removal from the 50,000-ton press, the uncut wheel was 44 inches in diameter and weighed 712 pounds.





Fig. 9. Here, a turbine-shaft forging made of a medium-high-temperature steel is set up in closed dies for final operation in a 20,000-pound hammer.

must be employed. The Wyman-Gordon Co. operates six closed-die heavy forging presses in the capacity range between 6000 and 50,000 tons. In addition, forging operations are performed on special equipment such as the ring-rolling machine seen in Fig. 8. The rolls rotate the work-piece and shape it under pressure. The part shown is a 40-inch diameter ring for a jet aircraft engine.

A turbine-shaft forging made of A-286 steel, one of the medium-high-temperature application alloys, is shown in Fig. 9 ready for finishing operation in closed dies set up on a 20,000-pound hammer. The part is cone-shaped, is 16 1/2 inches long, has a diameter of 21 inches at the large end, and weighs 233 pounds.

Forging Temperature Ranges Often Narrow

When forging the nickel-base superalloys, temperatures have to be carefully controlled, since

they must remain within a very narrow range. If an error is made by forging a part at a temperature either above or below the working range, the piece is apt to break or crack almost immediately. Failure of these materials can also

Mechanical Properties Attained by Forgings of the Nickel-Base Superalloy Astroloy

	Room Temperature	1400 Degrees F.
Ultimate strength, psi	190,000	150,000
0.2 per cent yield strength, psi	138,000	122,000
0.02 per cent yield strength, psi	127,000	110,000
Elongation, per cent in 2 inches	8	10
Reduction in area, per cent	10	12

Fig. 11. (Above) Refractory-metal forging 36 inches in "diameter" by 14 inches high weighing 1300 pounds. The material is columbium which has been alloyed with 1 per cent zirconium.

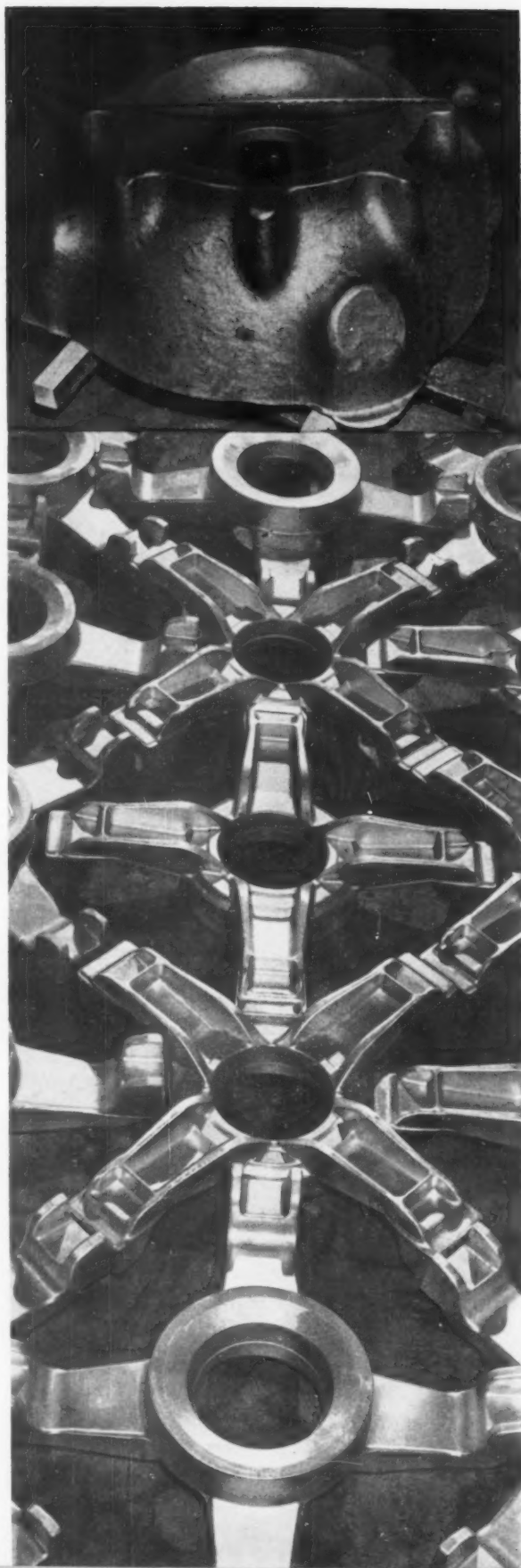
Fig. 12. (Below) Magnesium forgings for helicopters weighing 81 pounds and measuring 35 inches across the maximum dimension. They were made by closed dies in an 18,000-ton press.

occur at any time during a forging operation if the part has even a slight defect not revealed by a previous inspection. Generally the superalloy and refractory metals, being difficult to work, are extremely sensitive to any flaw and thus will fail during processing at an earlier stage than the more readily forged materials.

In addition to the narrow temperature range for forging, the amount and rate of deformation appear to be critical factors with some of the nickel-base superalloys. These factors are not only related to the alloy but, in many cases, to the particular part configuration. The development of improved mechanical properties depends both on the metallurgical composition and on the manner in which the parts are worked. Final part structure, in other words, is determined largely by the previous working history.

The superalloys normally require more forging operations. An alloy that is difficult to forge may need three or four die operations in contrast to, perhaps, one or two for producing the same shape in a more workable metal.

Turbine wheels for liquid rocket-propellant systems are being forged from many of the nickel-base superalloys. In a typical case, 50 inch diameter wheels forged by Wyman-Gordon Co. from Rene 41 have as guaranteed minimum mechanical properties at 1400 degrees F.: ultimate strength, 135,000 psi; 0.2 per cent yield strength, 115,000 psi; 0.02 per cent yield strength, 100,000 psi; elongation in 2 inches, 13 per cent; and reduction in area, 18 per cent. One of two rings cut from a 44-inch diameter, 712-pound composite wheel type forging of Rene 41 made on the 50,000-ton press is seen being checked in Fig. 10. Recently, capability in the forging of Astroloy has been extended to wheel shapes up to 40 inches in diameter having the minimum mechan-



ical properties given in the accompanying table. Both Rene 41 and Astroloy are metallurgical developments of the General Electric Co.

Refractory Metals Are Coming into Use

Refractory metals are required when the forging is to be used at temperatures of 1800 degrees F. and above. Nickel-base superalloy parts can sometimes be employed at reduced stresses up to about 2000 degrees F., but at temperatures above this value only a refractory metal can be of any reasonable service. Molybdenum forgings are now being made on a production basis for solid rocket motors. Columbian forgings, containing 1 per cent zirconium and processed at 2250 degrees F., have been made up to 36 inches in diameter (by 14 inches high) and weighing 1300 pounds (Fig. 11). Tantalum, tantalum tungsten, and tungsten have been forged on a developmental basis. Potential maximum application temperature range of tungsten forgings is up to 5000 degrees F.

Fig. 14. (Below) Largest closed-die aluminum forging produced for a commercial airplane, the Convair 600 four-engine jet. Work-piece is a bulkhead 12 feet long weighing close to 800 pounds that eliminates many fabricating costs.

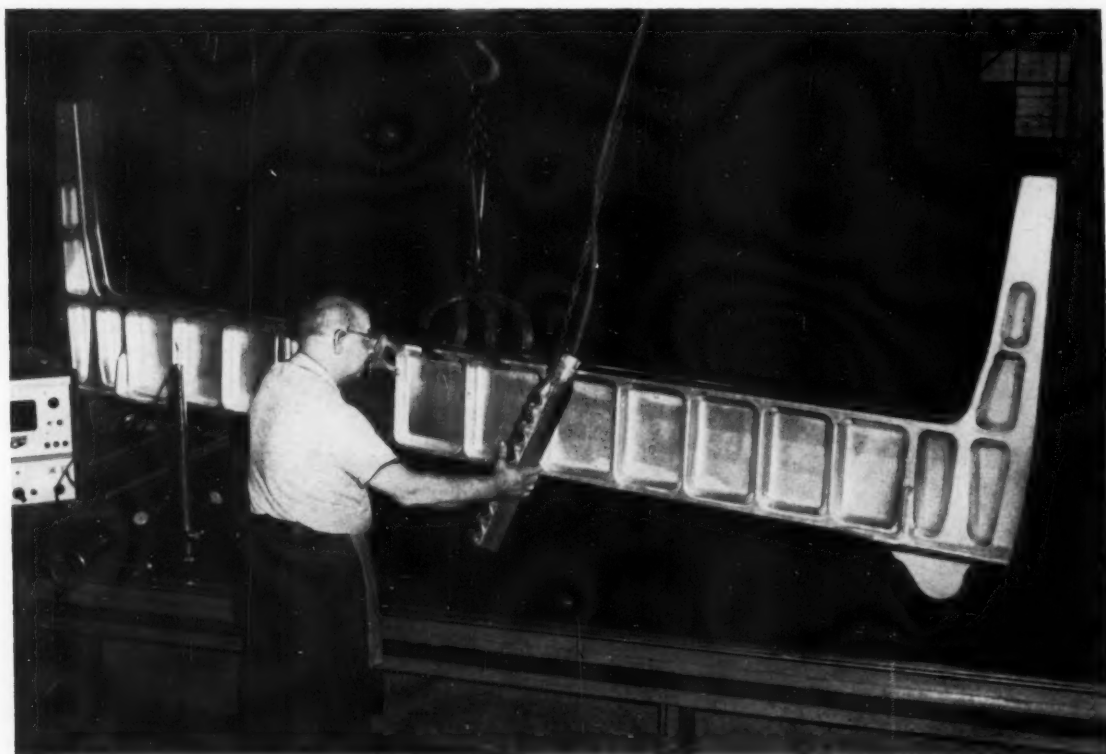


Fig. 13. (Above) Titanium forging for compressor disc to be used in a jet aircraft engine is seen here under-going inspection.



Fig. 15. Here a large aluminum structural component for an aircraft application is being forged in the huge 50,000-ton press.

Fig. 16. Forged end closure for a rocket motor case being contour-machined. Tracer follows master to automatically guide cutter.

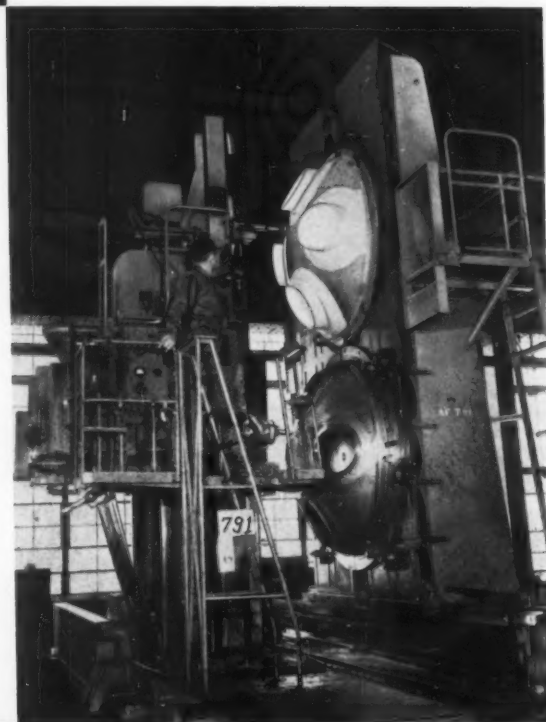
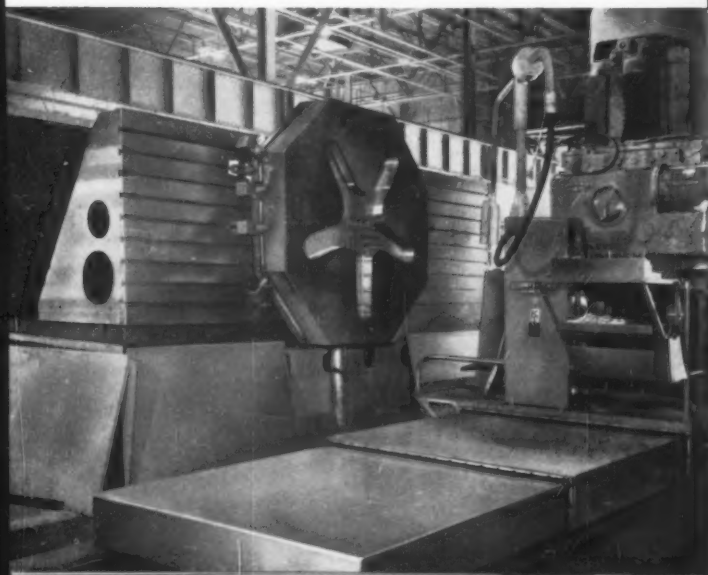


Fig. 17. This die for a magnesium helicopter forging is set up for a tape-milling operation.



Forging temperatures for the refractory metals are so much higher than those encountered in normal practice that special heating equipment and different handling techniques must be employed. Refractory-metal parts are produced in two different ways: first, by using strictly powdered metallurgy methods, the work-piece being machined from the compact. Secondly, forgings can be made from either a compact or an ingot cast from vacuum consumable-electrode melted material.

The refractory metals have one common problem, they lack oxidation resistance. In the case of molybdenum, oxidation deteriorates the metal. Columbium will crack due to gas diffusion along grain boundaries. Coating is the only way that has been devised so far to protect them. Attempts have been made to alloy these metals, but with very little success as far as gaining oxidation resistance is concerned. Although coatings appear to be a practical solution to the oxidation problem, coatings themselves are a real problem. A comparison of the effectiveness of coatings on columbium forgings showed that oxygen-gas contamination (which causes cracking along grain boundaries) was reduced from a 0.07-inch penetration (uncoated) to a 0.025-inch penetration (coated). The specimens were heated for two hours at 2100 degrees F. for the test.

Graphite, the standard lubricant for forging, has been the subject of much study. It has been found that coefficients of friction using graphite can be greatly reduced by allowing oxygen to be absorbed along the interlaminar layers of the graphite. Some recently compounded graphite type lubricants have additives that create an atmosphere to assist interlaminar adsorption of oxygen and thus reduce friction.

Canned Beryllium Forging Process Improves Mechanical Properties

Beryllium—with its high modulus of elasticity, low density, high heat capacity, and excellent strength-to-weight ratio—is destined to become an important metal in missile and space-vehicle design. Since cast ingots of beryllium have limited workability, most parts are made from powdered beryllium either by press forging or by vacuum press sintering. Forged parts, on the average, attain an ultimate strength of 53,000 psi, a 0.2 per cent yield strength of 40,000 psi, and an elongation of 2.4 per cent when tested at room

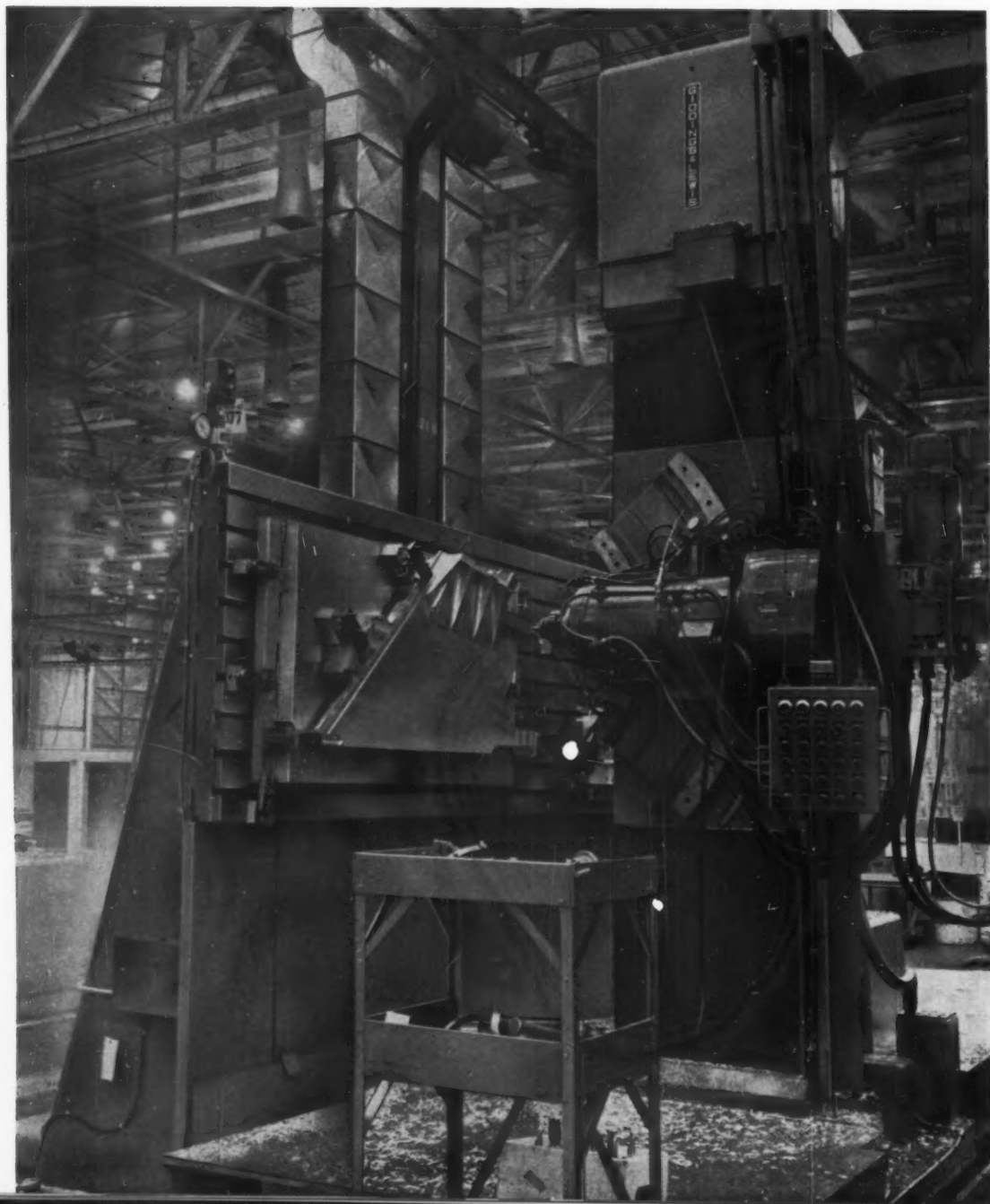
temperature. Vacuum press-sintered beryllium attains an ultimate strength of 40,000 psi, yield strength of 30,000 psi, and an elongation of 1 per cent under identical conditions. However, at temperatures between 1000 and 1500 degrees F. forged and sintered beryllium have about the same properties. At present, forgings of beryllium up to 72 inches in diameter are possible.

Titanium, with its extremely high strength-to-weight ratio, has become an important metal in missile and aircraft design. Closed-die forgings of the B120VCA titanium alloy are expected to attain, with continued development, yield strengths of up to 200,000 psi and elongations of 5 per cent. End enclosures 38 inches in diameter have been forged for rocket motor cases. Titanium forgings also have applications for such parts as pressure bottles for liquid rocket engines. A titanium forging employed as a compressor disc for a jet aircraft engine is shown in Fig. 13 being inspected.

One of the advantages of the large presses is that huge one-piece composite parts of the light metals, such as aluminum and magnesium, can be readily forged, thus eliminating the production costs of joining many smaller members. The largest closed-die aluminum forging ever made for a commercial airplane is seen being placed into a sonic inspection tank in Fig. 14. The forging is 12 feet long and weighs approximately 800 pounds. Another structural aircraft component is shown in Fig. 15 in the process of being forged from aluminum using closed dies in the 50,000-ton press. The closed-die forgings illustrated in Fig. 12 are 81-pound magnesium components (35 inches across) used in helicopters. They were made in the third largest forging press (18,000 tons) at the Grafton, Mass., plant.

Machining of dies, as well as of forged components, is receiving much attention at the company. Limited die-sinking on an experimental basis is being done under numerical control and by electrostatic-discharge machining. A die is seen set up in Kearney & Trecker numerically controlled equipment for contour milling in Fig. 17. A separate installation is maintained for the machining of beryllium forgings. Electrochemical milling is also one of the latest processes being used at the company for metal removal. A typical but more conventional machining operation is the contouring (Fig. 16) of a forged closure for a rocket motor case on a Pratt & Whitney Keller die-sinking machine.

5-Axis
Profiling under



tape control at Douglas

CHARLES O. HERB
Editor

Typical operations which emphasize the advantages obtainable through the use of tape-controlled modern equipment

AIRCRAFT STRUCTURES fabricated as late as the Korean War were predominantly made of sheet metal. Commercial jet planes since that time and space-age vehicles, however, have necessitated structures machined from solid slabs of metal. Also, more and more parts must be machined to tolerances of plus or minus 0.005 inch and closer.

Such tolerances are not unusual to the aircraft and missile industry, but as parts become larger and contours more complex, human errors have a greater chance of being magnified when parts are changed from machine to machine during the manufacturing process.

In conventional machining of spars and other components, the operator has process sheets or fabrication outlines to guide him. He is usually provided with holding fixtures, but frequently he must design his own setup, using knees, risers, and clamps for short-run parts. He must interpret the blueprints and process operations so that he can transform blank stock into a finished part. Many operations are subject to human error even with the best machine operators, and for each new work run, the same type of interpretation is subject to the old errors.

A new concept of profile-milling on work of this category evolved at the Long Beach, Calif., plant of the Douglas Aircraft Co. with the installation of a Giddings & Lewis five simultaneous-axis milling machine with Numericord control. This Variax machine has greatly reduced lead time, simplified tooling, and cut manufacturing time. In addition to the vertical, lateral, and longitudinal movements of conventional profilers,

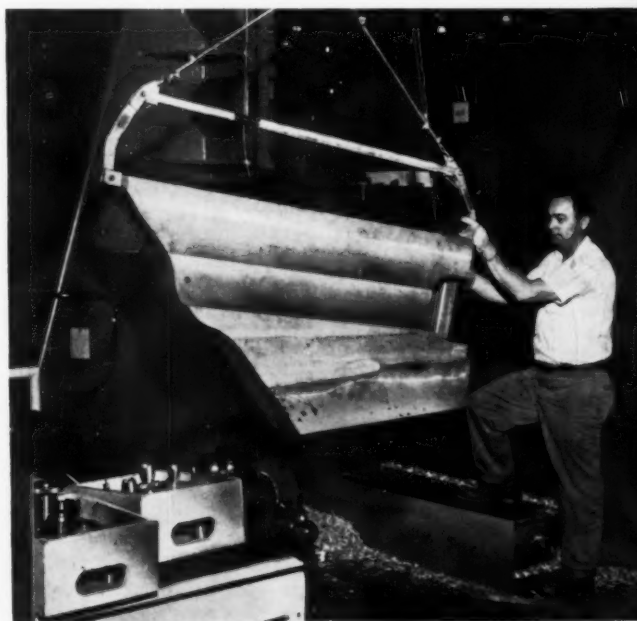


Fig. 1. Pylon spars machined from 870-pound ingots such as seen here have a weight of only 90 pounds after being finished.

Fig. 2. The outer face of the pylon spars is a lofted surface which must meet aerodynamic requirements for near-sonic speeds.



this equipment is provided with a column swivel and head tilt. All five motions can be operated simultaneously, making it possible to completely machine many parts in one setup.

The operator pushes one button to start the machine through a tape-controlled sequence and then stands by as a monitor to merely check the operation as the machine follows through the sequence. The multitude of operator decisions formerly necessary are now made during the numerical-control planning and programming process. Human decisions made at that time are thoroughly checked in the course of planning and producing the magnetic tape. Once the "Prove and Complete" operation is finished (this certifies the operation and the resulting part), there exists an infinitely repeatable machine control medium that is as usable the next week or the next year. Machine utilization goes up, while errors and scrap losses go down. An extra dividend is that operator fatigue is reduced to an insignificant level.

While "one shot" parts or tools can be made accurately and economically on the Variax machine, the most economical performance is obtained with short to medium production runs—that is, lots of twenty-five or less. To a great extent, the choice of work parts determines the degree of cost reduction or productivity gain. Although a five-axis profiler can properly machine a part which requires only three axes of motion, the advantage of the machine is not fully exploited in such setups. The shop objective,

therefore, is to assign as many jobs as possible to the machine that will necessitate full use of its possibilities. In the first fifteen months of shop operation the Variax was cutting during 77 per cent of the machine time available.

Although the machine fashions metal without human hands to guide it, human brains do command every movement by means of a magnetic tape. This tape is the end product of an assortment of the highest skills working as a closely interwoven unit. Proper tape preparation hinges on the ability to write an exact mathematical expression to describe a surface, a technique that Douglas linesmen perfected over a period of twenty years in describing or lofting the varying surfaces of aerospace vehicles.

Increments of a straight line or a curve, a knob or a cavity, are referenced in algebraic equations from index points, and every phase of operation is carefully plotted. From the engineering drawing the fabrication planner specifies the type of cutting operation and cutter requirements. The tool designer, meanwhile, is fixturing the part so that there will be as little change of position as possible, consulting all the time with the part programmer. The latter determines the cutter path after calculating the geometry of the part, and always keeps in mind the time element of all cutter motions.

For about 80 per cent of parts programmed, this information is fed into a small computer which produces the program on punched tape. The other 20 per cent of part configurations,

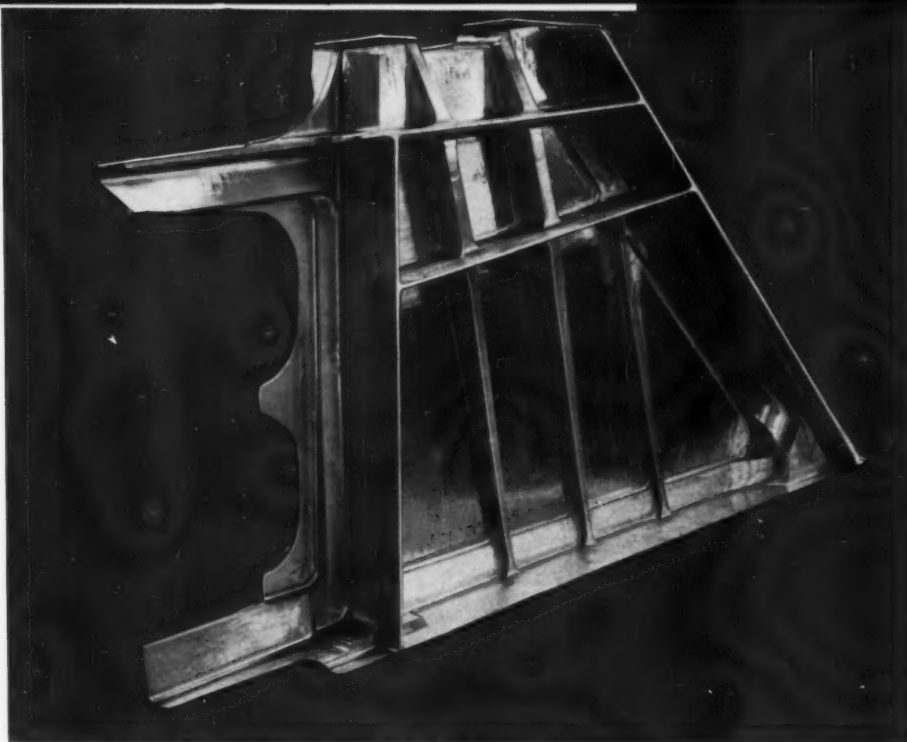


Fig. 3. The inner side of the pylon spar consists of thin webs and pockets up to 4 inches in depth. The pocket bottoms are canted and the webs are nonperpendicular.

being too involved for the small computer, are handled by an IBM 7090 computer whose product is punched cards.

The cards are run through a Translator which produces a punched tape compatible with the punched tape of the small computers and, both fed into the Numericord Director, the information is interpolated and recorded on magnetic tape. The signals on the magnetic tape are the language of the Variax. With direction changes of the cutter path as small as 0.001 inch, and full control of all machine movements, this tape is a permanent command record of the part to be made.

To date, the most comprehensive and challenging project to be programmed and processed is a set of large front-spar members, one of which is seen on the vertical table of the machine in the heading illustration. These major structural components are used in the pylon which supports a missile under the wing of the launching aircraft. The parts are machined from 7079 aluminum hand-forged billets such as seen being loaded on the machine in Fig. 1. Each billet weighs 870 pounds. Approximately 780 pounds of metal are machined away, leaving a part 7 by 28 by 70 inches in over-all dimensions and weighing about 90 pounds.

The outer face of each part is a lofted surface (shown in Fig. 2) which must meet aerodynamic requirements for near-sonic flight speeds. The inner side of the pylon spar (Fig. 3) consists of thin webs and pockets up to 4 inches in depth.

Pocket bottoms are canted to approximate the airfoil surface. These canted planes with non-perpendicular webs present a difficult machining problem for any machine with less than five axes of motion.

Originally, conventional types of profiling machines were selected for the spar production. Ninety-four fixtures, jigs, and special tools were planned for the two-part configuration. When the decision was made to utilize the Variax machine, eighty-six of the specially planned tools were found to be unnecessary and were canceled before manufacture. The saving in cost of tools for a production program more than pays for the numerical-control programming.

Various types of work handled on the Variax machine, with large savings in production time and costs, will be here shown. For example, in Fig. 4 is a doubler for the DC-8 fuel filler neck which is machined from plate stock. In addition to the visible detail, the part has a tapering web thickness and the back side is machined to the approximate wing contour. The part is completely machined in only two positions on the Variax and without any designed holding fixtures. A universal bolster plate is the only holding device. Machining by numerical control saved 235 hours of tool design and fabrication time. The lead time was reduced twelve weeks, the setup time was reduced 90 per cent, and productivity was doubled.

The C-133 fitting in Fig. 5 was rough-machined on both sides and then finished, in two setups.



Fig. 4. Component for jet airplane on which 235 hours of tool design and fabrication time were saved by machining on numerically controlled equipment.



Fig. 5. Airplane fitting fabricated from solid stock on a numerically controlled machine with a 92 per cent saving in setup time, a 31 per cent saving in machining time, and an 84 per cent saving in loading time.

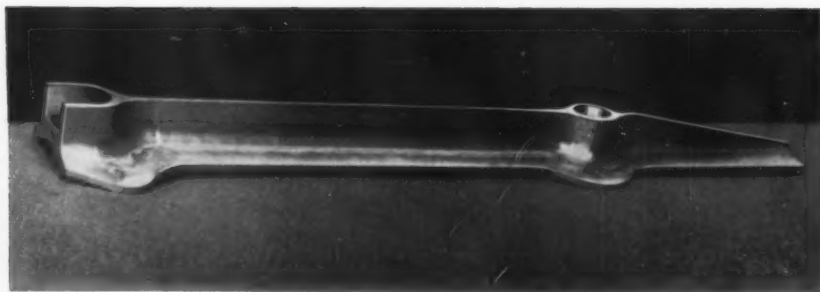


Fig. 6. Front-spar splice stiffener which was completely machined in only two positions on the Variax machine. The total time involved to produce the part from bar stock was 80 minutes.

Precision roughing cuts on both sides provided better control of warpage. Unique clamping methods permitted maximum machining with minimum of clamp changing and part loadings. The setup time was cut from 37.9 hours per part, formerly required, to only 3.1 hours, or 92 per cent. The unit time was reduced from 6.33 to 4.38 hours, or 31 per cent. Loading time was cut from 25 to 4 hours, or 84 per cent.

The C-133 front-spar splice stiffener in Fig. 6 was completely machined in only two positions on the Variax machine. A fixture surface required for the second position was machined right on the Variax to match the surfaces generated in the first operation. The part was completely machined from bar stock in 80 minutes.

The fuel-probe support fitting for the DC-8, which is shown in Fig. 7, required four machine motions in order to shape the boss at an angle with the base and to machine a pocket, at the same angle, from the reverse side. This part is completely machined in two positions on the Variax, with a single fixture being used for both left- and right-hand parts. The floor-to-floor time is only 70 minutes, a saving of more than 7 hours per part over the previous method. More than 300 hours were saved in tool design and fabrication. Over 400 parts have been produced from one magnetic tape.

The DC-8 seal fitting in Fig. 8 demanded rapid and accurate response of both twist and tilt motions of the machine to negotiate the corner fillets. This motion capability eliminated a number of tools that would be necessary in conventional machining. Nine fixtures would have been required to machine this part by conventional methods, whereas with numerical control of the Variax machine, a universal bolster plate was the only fixture necessary.

The C-133 engine mount backup fitting in Fig. 9 is machined from a solid forging. The setup time on this part dropped from the 13.8 hours involved when the part was machined on a conventional profiler to only 1.2 hours. The unit time dropped from 2.63 to 1.09 hours, or 59 per cent; and the loading time, from 18 to 2 hours, or 89 per cent.

Fig. 7. Four machine motions of the Variax were required in shaping the boss on this part and machining a corresponding pocket in the reverse side.

Fig. 8. Both the column-twist and head-tilt motions of the Variax were required to machine the outer corner of this fitting, the complete part being produced from a solid block of aluminum.

Fig. 9. Engine mount backup fitting produced from a solid forging in only 1.2 hours of setup time, 1.09 hours of machining time, and 2 hours of loading time.



Novel milling chuck cuts cost of the B-70

Part of every government contractor's capability rating is his record of cost-reduction successes in manufacturing. A B-70 bomber is an exotic and complex weapon, but the methods used to effect savings in its manufacture are simple, yet ingenious

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Associate Editor

THE B-70 BOMBER is a weapon of awesome speed and defensive deterrence. Methods used in its construction had their inception in the B-58, which was the first nonriveted air vehicle to be constructed of honeycomb panel with the skin of the ship functioning as a hull. The B-58 has a skeleton covered, for the most part, with aluminum honeycomb panels. They contribute to the strength of the fuselage and portions of the wings. But on the undersides of the wings, aft of the engine nacelles, the honeycomb is 17-4 Ph stainless steel, brazed to make up the "sandwich." The reason for the stainless honeycomb is that the heat from the jet engine's exhaust, rising under the wing when the plane is taxiing or idling, would soon ruin aluminum honeycomb, which is built up using an organic adhesive, usually having a rubber or epoxy base.

Brazed stainless-steel honeycomb is used throughout the B-70 (heading illustration), but mainly because the aircraft is expected to travel at speeds in excess of Mach II. Thus the friction of air passing over the plane's surface is expected to be great enough to cause temperature rises that would dangerously weaken anything less than high-temperature brazed stainless in the

precipitation-hardening class. The manufacture of brazed stainless honeycomb sandwich has proved a problem to a number of airframe contractors and subcontractors ever since the inception of the B-58.

As has been stated, the honeycomb panels are structural members. Therefore they must be securely fastened at the edges to each other and also to the skeleton of the aircraft. This means that around the edges of each panel there must be a frame channel section (Fig. 1) brazed to the inner and outer skins, Fig. 2, providing a tongue. These members are called close-offs by personnel at the Columbus, Ohio, plant of North American Aviation, Inc. Obviously, the close-off members must be designed with typical aircraft factors in mind: high strength-to-weight ratio, compatibility with other parts of the structure, high dimensional accuracy, and sufficient ductility so that they can be shaped to the complex contour of the honeycomb panel. Once all conditions have been satisfied, the resulting assembled structure must present a mirror-smooth exterior contour with virtually no joint cracks, in addition to being light, strong, and capable of withstanding Mach II-plus skin temperatures.



The edge close-off inserts have the same accuracy as the rest of the panel and must be made of the same material, which is 17-4 Ph stainless, purchased in the form of extrusions 24 feet long. There are a number of different section designs required, Fig. 3. Production quantities of the B-70 are relatively small. Therefore the quantities of any one close-off section are relatively small—too small to justify the cost of extrusion dies that would deliver closely dimensioned lengths of close-off edges.

Instead, the stainless extrusions are purchased with a considerable volume of "clean up" stock, as is shown in the shaded area of Fig. 3. Then they must be machined full-length by milling. Here again, tooling costs were reduced because the company found it could adapt relatively small, standard horizontal milling machines for the job, instead of having to tie up a big miller

capable of chucking and traversing a part 24 feet long. For profiling the close-off sections North American's manufacturing engineers contrived a novel slip fixture for holding and supporting the long extrusions. The fixture takes the place of the usual milling vise on the table of a standard 5-hp Kearney & Trecker milling machine, Fig. 4.

The fixture form obviously has to be specially made for each cutting pass. There may be several passes because all surfaces must "clean up." Each set of fixture shoes is designed to support the work all around, and the part is held against bronze friction shoes by a spring block whose tension is adjustable. The arbor of the machine is fitted with cutters (specially ground to form, when necessary) to remove the desired metal. Some make straddle cuts.

At the start of a cut, one end of the work is inserted in the fixture, and the table is brought



Fig. 1. Frame of milled stainless channel makes the honeycomb-panel close-off.

up so that the cutter plunges to full depth. The table is not used for longitudinal traverse because of the design of the chuck and the unusual manner of feed. The holding fixture is constructed so as to support the work as thoroughly as possible during the cut, while still giving clearance to the cutter.

Obviously, the extruded work-piece must be fed to the cutter its full 24-foot length. Thus, because of the nature of the fixture, the work, and the cut, some means other than table lead-screw is needed to give longitudinal travel. Motion of the work is provided by fastening the lead end of the work to an endless roller chain, as in the foreground of Fig. 4. The external reduction gear pulls the chain and draws the work (under the cutter and through the slip fixture) at a predetermined rate. The work slips through the jaws of the fixture, being supported all over. The arrangement resembles a draw-bench.

In order to provide simple work-flow continuity of the operation and to minimize handling and floor space, two milling machines have been reserved to the channel milling, arranged so that operations proceed back-to-back, Fig. 5. In this manner work parts from the infeed bench of the left-hand machine run out toward the right. From the draw-bench of the first machine the parts are simply lifted to the infeed table of the right-hand miller, whence they run out to the left. From here they can go back into the left-

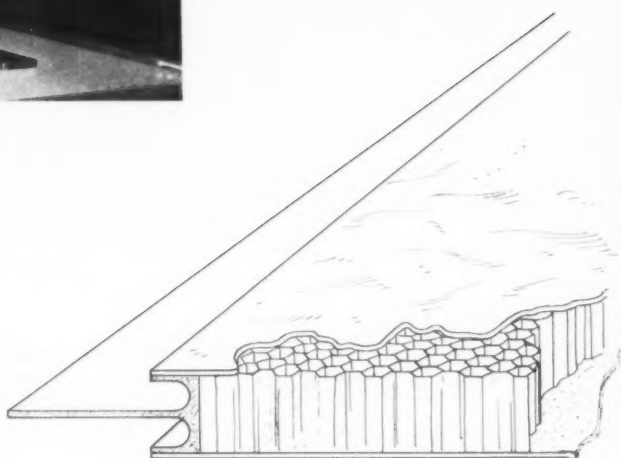


Fig. 2. Honeycomb sandwich build-up shows the positioning and function of the edge close-off section (Top right in Fig. 3).

hand machine for the third pass, then move over to the right-hand machine for a fourth cutting pass, if necessary.

In profiling shapes, straight-side mills or stagger-tooth cutters are used. To maintain the cutting pull against the chain, conventional milling is used, in contrast to climb milling. Cutter diameter is kept as small as possible to minimize side deflection. The depth and width of the cut determine the feed rate, which may be from 1 to 10 ipm. Cutter speed is from 45 to 60 sfpm. A 125-micro-inch finish is easily maintained.

Different fixture jaws and friction blocks are needed for each successive pass and, similarly, a different form is needed for the cutters. Some idea of the variety of different close-off forms is shown in Fig. 3. Obviously only a few 24-foot

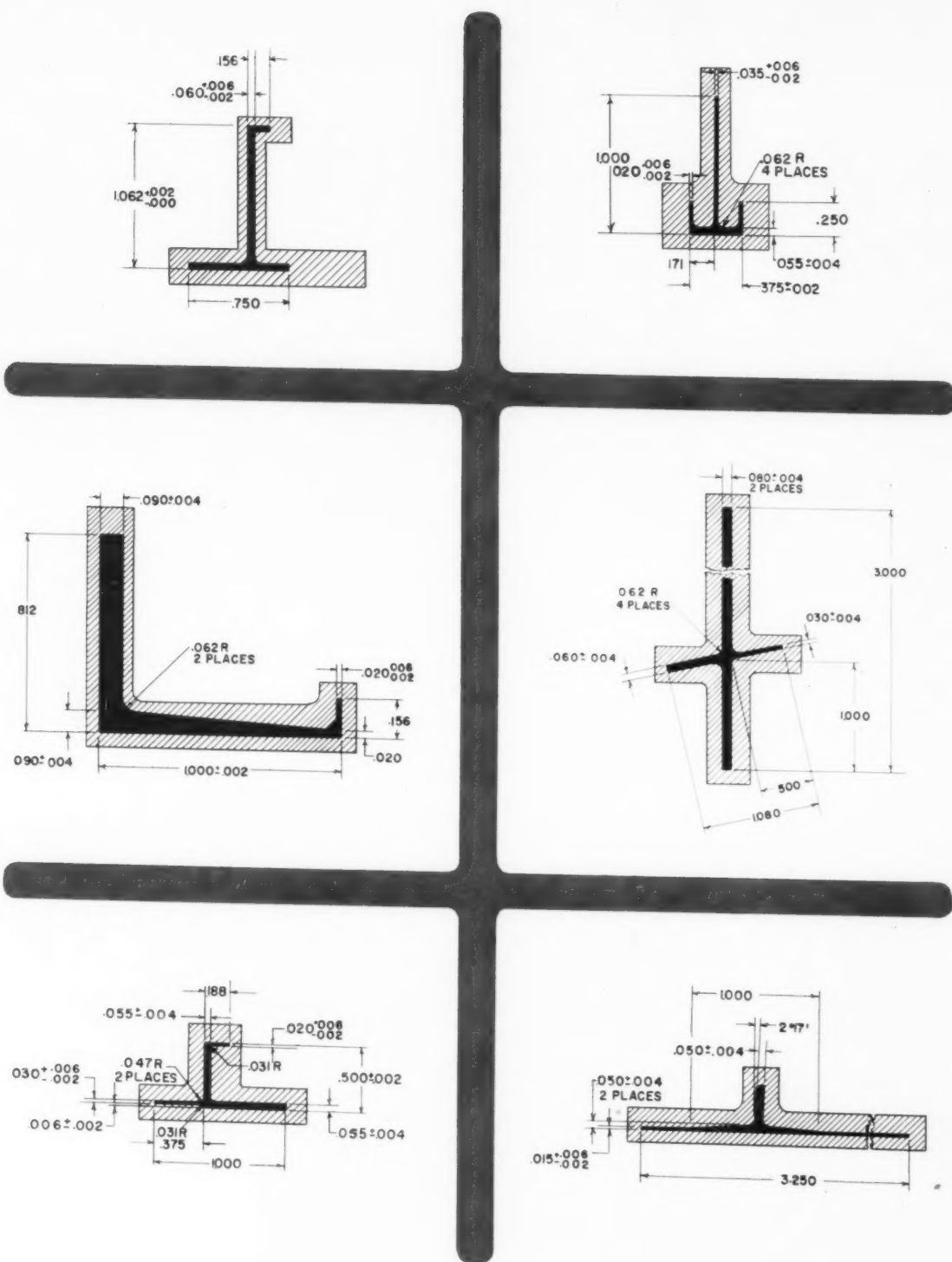


Fig. 3. Variety of close-off sections is machined from 17-4 Ph stainless extrusions. The shaded portion is milled off in the slip fixtures. The solid black area is the close-off section used.

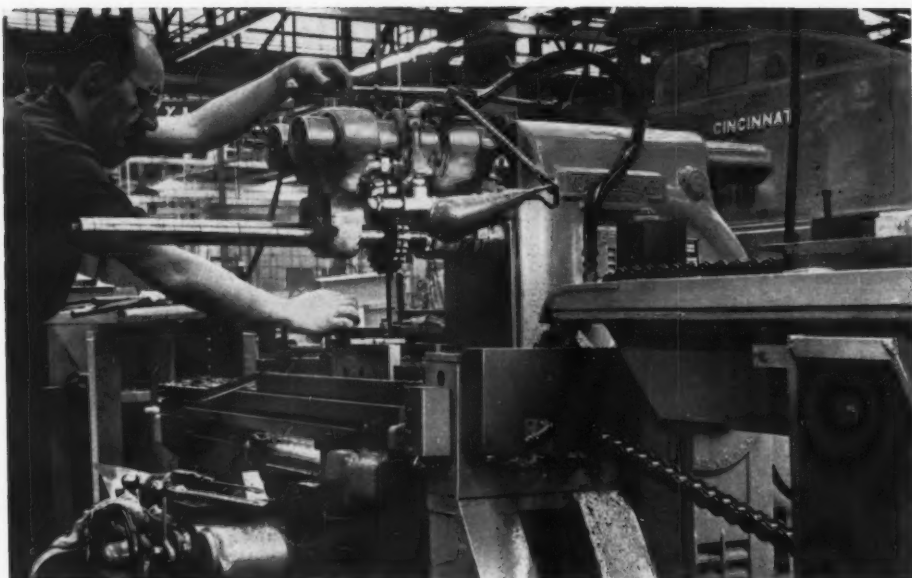


Fig. 4. Rugged support is a requirement of the slip fixtures used in milling the stainless edge close-off sections.

pieces of each form are needed for each aircraft because the airplane is still in limited production only.

The concept of the slip-grip fixturing provides for precisely machining an infinite variety of different close-off section forms without the purchase of special machinery, and with the need for only limited floor space. The fixture design is

such that pressure shoes and supporting members are interchangeable. Also, the change-overs are accomplished rapidly. Thus down time is kept to a minimum. Obviously the production of this type of arrangement is not large. However, it has been carefully planned to produce maximum cost reduction within the scope of its operation as a short-run arrangement.

Fig. 5. Back-to-back floor arrangement permits partly milled work from the first pass (center machine) to be shifted to the feed bench of the second-pass machine on the right. The reduction gear in the foreground pulls



the heavy roller chain on the bench, drawing work with it from the miller at the right.

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Automatic unit indexes itself over long contoured panels

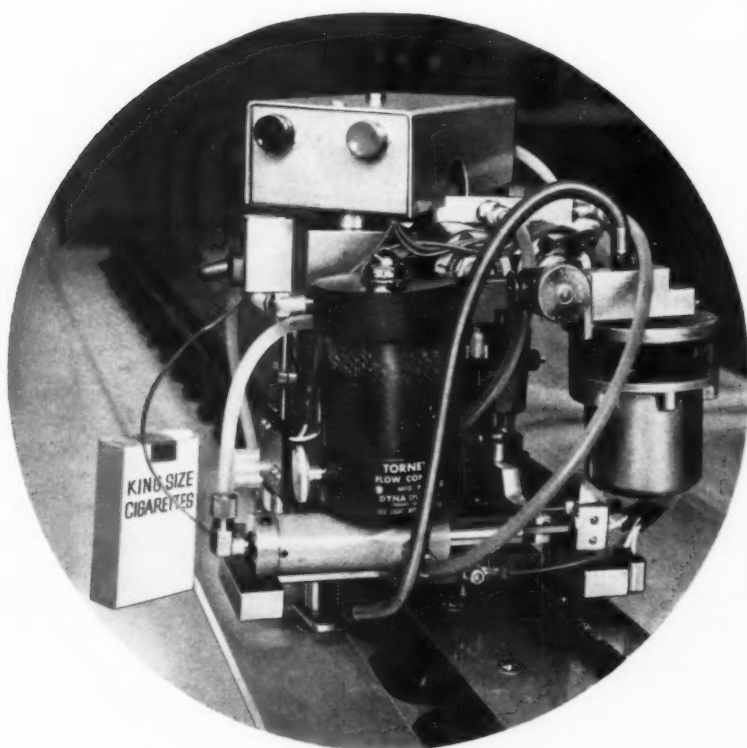


Fig. 1. Self-contained drilling unit which rides on flat track that lies on long work and adjusts itself to curved and contoured surfaces.

Up to ninety holes are drilled per minute through aluminum honeycomb sandwich sections—drilling torque, speed, and feed are automatically regulated

PRECISION MACHINING OPERATIONS on large and somewhat flexible sheet-like parts are usually difficult and sometimes approach the impractical, especially if accurate indexing of the work or machine is necessary. When the sheet-like part has crowns, twists, contours, or other deviations from normal surfaces, additional complications arise. If the operation is performed by a tool-head mounted on the cross-rail of a gantry, continual reindexing of the part may be required to keep the work normal to the tool.

This problem cropped up in its most complex form at the Norair Division of Northrop Corporation, Hawthorne, Calif., when it became necessary to prepare large and contoured sandwiched wing panels for laminar-flow control. A solution to such a problem was the development of a small machining unit that rides on the work itself and is automatically adjusted to compensate for changing work contours.

The large panel sections are made up by sandwiching honeycomb core between a pair of skins. Closely spaced and parallel small plenum-chamber grooves, each 3/16 inch wide, 0.20 inch deep, and having 0.020-inch bottom radii, must be milled the length of the upper contoured skin surface. A line of holes, each 0.052 inch in diameter

and spaced 1/4 inch apart, must be drilled in the bottom of each plenum-chamber groove, down through the honeycomb core material, and on through the under sandwich skin.

After this drilling and other operations, a second skin is bonded to the sandwiched panel's top skin. This second skin effectively seals off each of the milled plenum-chamber grooves. The final machine operation involves sawing a 0.004- to 0.008-inch slit through this external skin layer directly over the center of each plenum-chamber groove.

With this construction, laminar-flow air can pass through the slit into the plenum chamber, then down through the drilled holes to the interior of the wing. As the volume of air that follows this path must be closely controlled, the width of the slit and the diameter of the holes and their number must likewise be closely controlled. Thus, tight tolerances must be maintained in milling, drilling, and slitting.

These multiple machining operations, which must be accomplished normal to a contoured or twisted surface, would be extremely difficult to accomplish with a head mounted on a gantry cross-rail. Initial indexing of the work in cuts ranging up to 17 feet in length would be difficult,

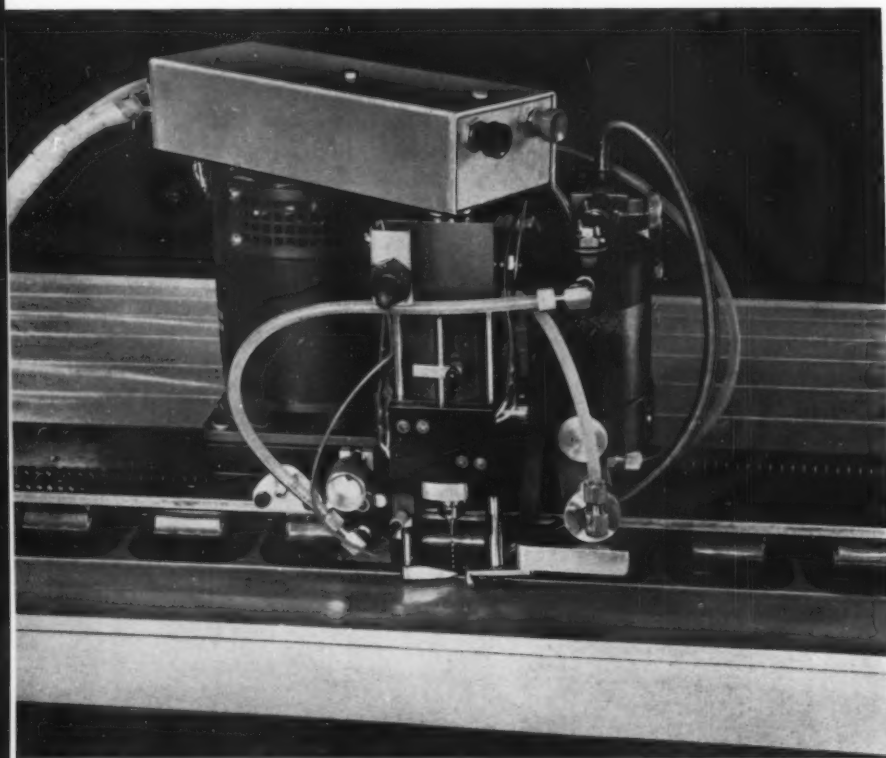


Fig. 2. View of drilling unit showing drill-bushing foot and tool-breakage detection circuit. Vacuum cups used for holding the track to the work are clearly seen.

and continual reindexing of the work, as machining progressed, would be necessary in a gantry setup.

In studying this problem, Norair manufacturing research and development engineers reached the conclusion that the milling, drilling, and sawing could be accomplished by the use of small machine tools operating under accurate control, with the units guided by the work-piece itself. Research, design, and development work was inaugurated which led to the building of the drilling machine shown in the illustrations. This self-propelled machine is mounted on a flat, somewhat flexible steel track that conforms to the contour of the work. A machine designed along the same principles is also being built for performing the milling and slitting operations.

The track for the drilling machine is attached to the panel surface by means of rubber vacuum cups. It is a strip of cold-rolled steel 1/4 inch thick by 4 inches wide and extends the length of the work. Each vacuum cup is equipped with molded-in metal legs which hold the track a uniform distance above the work-surface. When a 28-inch vacuum is pulled on the cups, they clamp down tightly against the wing-panel surface with enough force to cause the track to conform to the

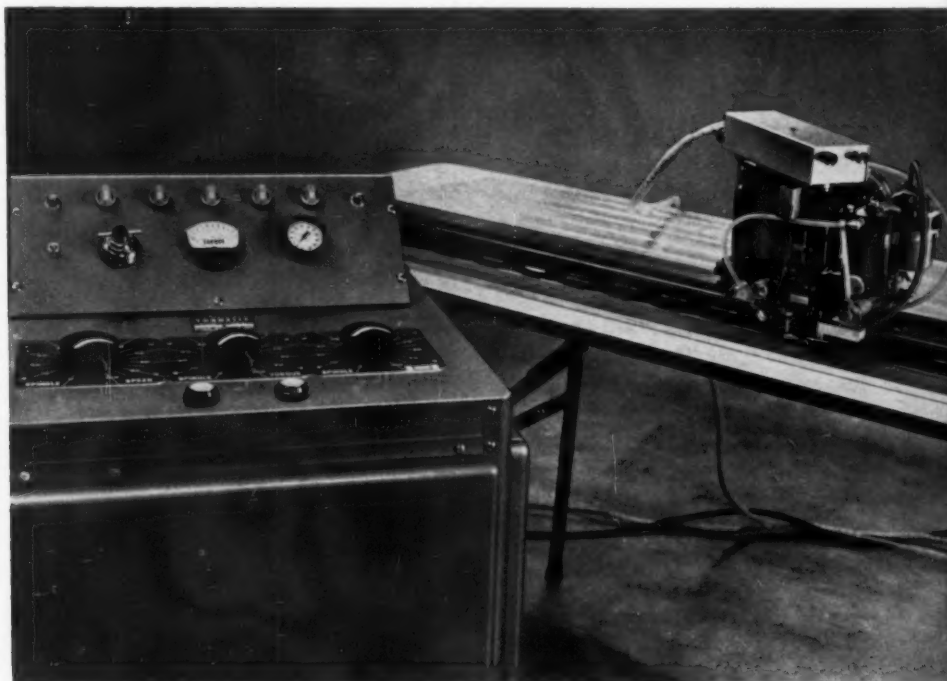
surface contours of the panel for its full length.

The self-propelled drilling unit is attached to the track by means of three aluminum-bronze gibs. There are two stationary gibs on one side and an air-cylinder-actuated gib on the opposite side, spaced between the other two. The movable gib is actuated prior to drilling so that it tightens and loosens in synchronization with the drilling cycle as the unit moves forward in increments over the work. A ratcheting sprocket, which is also an air-operated mechanism, provides forward movements of the drilling unit in 1/4-inch increments. This mechanism is actuated by the return cycle of the drill-feed cylinder.

There are various intermittent locations on the wing panels which do not require drilling; consequently, provision has been made for feeding the drilling units along such areas of the work without stopping. An electrical sliding contact is provided between the track and the drill carriage, and insulating tape is placed on the track over the area not to be drilled. Thus, when the circuit is broken, the drilling indexing system is initiated progressively until the insulating tape is negotiated and the sliding contact again touches the track and reactivates the drilling sequence.

The drilling unit was built to Norair specifica-

Fig. 3. Tornetic computer which regulates the amount of torque applied to the drill through a feedback circuit which responds to cutting conditions.



tions by Dyne Systems, Inc., Torrance, Calif., and employs the Tornetic control. With this control, the drilling torque is continually measured electronically and maintained at a constant level. Thus, as the drill becomes dull, an automatic feedback, initiated by the cutting tool, automatically regulates the drilling torque, speed, and feed. This results in more consistent chip removal and far greater tool life than when the chip load is governed by a set rpm and a constant drill feed.

When starting a drilling operation with a properly pointed drill, approximately ninety holes are drilled per minute. The drilling rate slows down gradually until a drill change is indicated. It would continue to slow until a very dull drill would turn against the work, without making any progress but still not breaking. When a new drill is inserted in the chuck, the drilling rate will again jump to the maximum amount.

Drilling the bottom skin of the honeycomb sandwich proved to be quite a problem because the small-diameter drills (0.052 inch) could not be supported inside the honeycomb. With conventional drilling methods excessive drill breakage was encountered. Because of the rapidity of

the drilling action, a method had to be devised for stopping the feed instantly in case of a broken drill. An automatic drill-breakage surveillance system was, therefore, developed.

The honeycomb bonding adhesive is so abrasive that when using conventional drilling methods approximately forty-eight holes per drill was maximum. With the Tornetic computer system over 1000 holes are consistently achieved per drill, and drill breakage is held to a minimum.

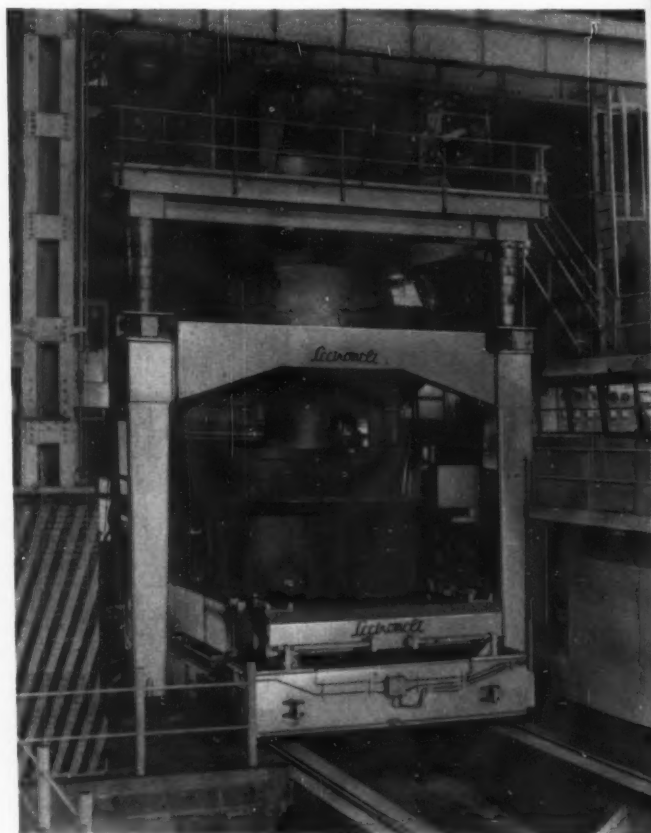
Since the drilling unit is completely automatic and provision is made for instantly stopping the unit in the event of a broken drill, the operator is alleviated of the responsibility of watching the unit during its drilling operations. Therefore, the only man-hours involved are in the actual setup of the tracks and the periodic changing of drills.

After negotiating the length of the track on work the drilling automatically stops, is taken off the track, and mounted on a new setup. Then, while the unit is drilling the length of the new track, the track is relocated in a new position. The total linear footage of track to be negotiated on existing contracts amounts to approximately 7 1/5 miles. This encompasses the requirement of drilling more than 1,800,000 holes.

Crucible Demonstrates Degassing Process in Steelmaking

During a tour and technical session conducted recently at the Midland, Pa., plant of the Crucible Steel Company of America, 170 tons of open-hearth steel were processed through the first Dortmund-Horder vacuum-treatment unit to be installed in the United States. This unit removes oxygen and other gases. Alloy additions can be made after the removal of gases, thereby preventing the formation of nonmetallic inclusions. A more uniform and higher level of quality is obtained, and in tonnage quantities. Indications since the unit was placed in experimental operation in October, 1960, are that there is a definite improvement in the uniformity of quality throughout a heat and from heat to heat. The unit handles the full product of a heat in approximately half an hour.

Dortmund-Horder unit with ladle of molten open-hearth steel in place and snorkel tube in down position.





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THINKING WITH MANAGEMENT

The Need for Organized Product Planning

RELATED to the importance of new-product development is the expenditure that a company makes for research and development operations. If increases in plant capacities are valid indicators, those firms that spend the most for research and development, on the average, have experienced the greatest growth. For example, the machinery industry—which is represented by a large percentage of the readers of *MACHINERY*—the chemical industry, and the electrical machinery industry all spend more than 2 per cent of their sales dollars for research and development. Using growth of plant capacity as a measurement, these groups easily outclass such industries as petroleum, rubber, fabricated metals, food, textiles, and others, who budget approximately 1 per cent or less of their sales dollar for research and development.

Statistics show that for every five products emerging from research and development departments as technical successes, there is an average of only one commercial success. Even after product and market tests, nearly half of the new products that are fully commercialized fail to materialize as financial successes. This emphasizes the importance of recognizing that the development and exploitation of new products is a concrete business function, not an abstract mystery. The management processes involved can be organized, and they can be controlled. Thus, they can be managed.

It is a known fact that companies vary widely as to the effectiveness of their new-product programs. Booz, Allen & Hamilton, one of the nation's foremost management consulting organizations, states that even between major companies in the same industry, efficiencies in new-product

development range from 1 per cent to over 50 per cent. Efficiency is here defined as the percentage of a company's new-product expenses devoted to the successful, as against the unsuccessful, products. Common characteristics appear in management practices which can generally be used to evaluate the relative degrees of efficiency and success between companies in new-product development.

Additional facts make it imperative that a company manage its new-product program the same as any other phase of the business. When a company selects and develops a new product, it is really choosing the kind of business that will be its way of life. Simultaneously, it decides who its customers will be, what its competition will be, the channels of distribution it must use, and the facilities and skills which will be required to manufacture the new product.

When one couples the above concept to the fact that almost all new products experience a typical basic life cycle, it becomes obvious that not only is new-product management required, but that it must be the very best available. Close similarities in life cycles of numerous products illustrate that eventually every product is preempted by another, or else degenerates into profitless price competition. Thus, the organization must also be dynamic and creative.

All of these facts make it crystal clear that new-product planning is at the heart of all business strategy. The sooner a company awakens to these basic facts of life, the better are its chances for success.

Getting started on the organization and management of a new-product function is not really difficult. Available aids are: magazine articles, books, conferences conducted by the American Management Association, extension courses in universities, and professional consultants. If the need is an emergency, or if there is no staff member immediately available to assume this responsibility, a manufacturer may want to consider retaining one of the knowledgeable consultants in this new-product development area.

Simple Formulas for Tangent Arcs

L. KASPER

In developing engineering layouts, the draftsman often finds it necessary to draw an arc that is tangential to two circles of a given diameter. He must then determine the radius of the arc. Formulas are here given for several such cases.

In Fig. 1 is shown an instance where the two circles are of different diameters. Radius R is the unknown dimension to be determined. The known factors are the radii r and r' of the given circles, the center distance D , and the points of contact indicated by dimensions X and Y .

To solve this problem, it is first necessary to determine angles A and B by means of the equations:

$$\cos A = \frac{X}{r}$$

$$\cos B = \frac{Y}{r'}$$

If the radial lines from the center point of the arc are continued through the circles, the vertically opposite angles A and B will be the same, and angle E will equal $180 - (A + B)$ degrees.

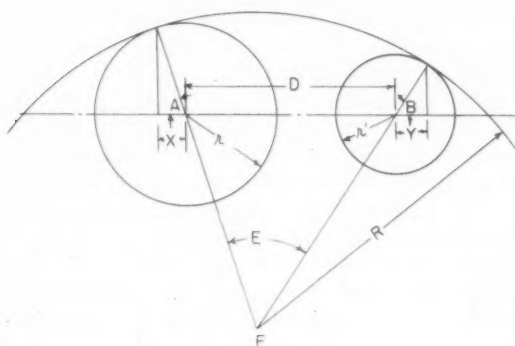
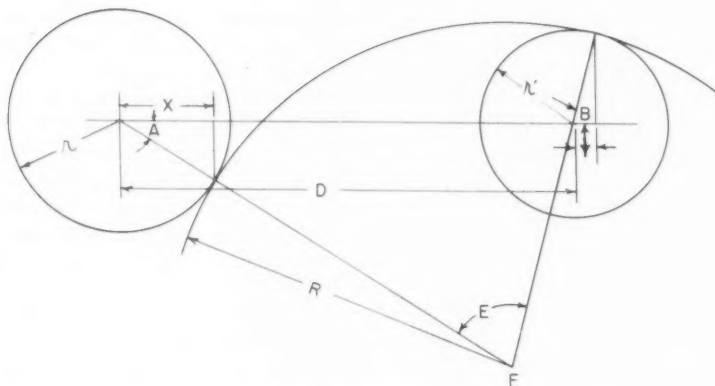


Fig. 1. (Above) Diagram of a condition where an arc is drawn tangent to the outside of two circles.

Fig. 2. (Right) Condition where an arc is drawn tangent to two circles, one outside of the arc and one inside.



The three angles and one side of triangle ABF now being known, it is merely necessary to find the length of one other side and add the radius of the corresponding circle. Radius R can, therefore, be determined from either of the two following formulas:

$$R = \frac{D \times \sin A}{\sin [180 - (A + B)]} + r'$$

or
$$R = \frac{D \times \sin B}{\sin [180 - (A + B)]} + r$$

A case where it is necessary to determine the radius R of an arc that is internally and externally tangent to two circles is shown in Fig. 2. The procedure is the same as in the preceding example, but there is a slight change in one of the formulas. A minus sign is substituted for a plus sign in front of one term. The formulas thus become:

$$R = \frac{D \times \sin A}{\sin [180 - (A + B)]} + r'$$

or
$$R = \frac{D \times \sin B}{\sin [180 - (A + B)]} - r$$

In drawing an arc to make internal and external contacts, it must be understood that such an arc cannot be drawn under all conditions. If the specified points of tangency are both on the center line of the two circles, the tangent arc will be a semicircle, and there is no problem. It is merely necessary to locate the center of the required arc midway between the points of tangency. Under all other conditions, the points of tangency must lie in opposite sides of the center line through the circles.

The 1961 Annual Meeting of AGMA

One of the outstanding features of the forty-fifth annual meeting of the American Gear Manufacturers Association held at the Homestead, Hot Springs, Va., on June 4 to 7, inclusive, was a comprehensive report about the "International Conference on Gearing, October 1960, Essen, Germany." The author of the report was John Erler, consulting metallurgist, Farrel-Birmingham Co., Inc., Ansonia, Conn.

The report discussed at considerable length a paper that dealt with the Novikov gear system and other special gear systems for higher load-carrying capacities. Another paper dealt with the manufacture of gears by other means than with machine tools. Hot and cold forming especially were considered. It was pointed out that dimensional changes after cooling of the forging must be carefully calculated in the fabrication of the dies to obtain the exact finished dimensions.

The contact of the forging with the dies must be as short as possible, the forging by this process being carried out at 2000 to 2300 degrees F. for bevel gears, followed by cold forging for higher accuracy. After hot forming, the accuracy is in the order of 0.002 inch. The combination of hot and cold forging reduces the variation to 0.0008 inch. Cold-formed dies will produce between

8000 and 10,000 pieces. Gears forged by this method can be heat-treated. Experience has shown that the warpage can be reduced 30 per cent over the same gears produced by other processes.

It was also stated that the resistance to scoring for this type of gear is improved approximately 20 per cent. The limitation of this process is the removal of the forging from the closed die. In many cases, a forging of this type has no economical advantages, and the tooth size must be less than module 2 1/2 to 10 DP.

Other papers dealt with the noise of gear units and the manufacture of silent gears, and the construction of large gear drives. "Precision Gearing for Fine Mechanical Work," presented by Richard L. Thoen of General Mills, Inc., Minneapolis, Minn., was one of the few papers presented by an American.

"Tufftriding"—bath nitriding of nonalloy or low-alloy construction steels—was another paper extensively referred to in the Erler report.

C. R. Burrell, president of the Tool Steel Products Sales Corporation, was presented with the Edward P. Connell award at the banquet. The presentation was made by Walter L. Schneider, vice-president of the Falk Corporation.

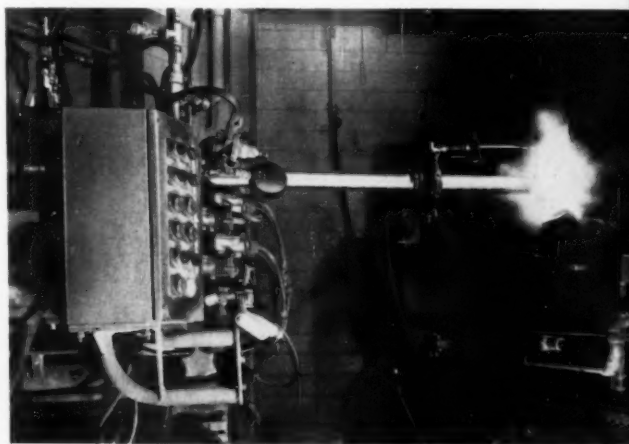
New "Flame-Plating" Plant in Operation

A new plant for applying "Flame-Plated" coatings is now in full production at North Haven, Conn. As the third such facility of Linde Company, division of Union Carbide Corporation, the plant was built primarily to serve industries in New England and the North Atlantic States.

Plant layout includes space for receiving and shipping, preparation and storage of coating materials, finishing and inspection of parts, in addition to four cubicles for the Flame-Plating equipment. These enclosed areas are designed with double, soundproofed walls, windows, and doors to isolate the detonations of the guns.

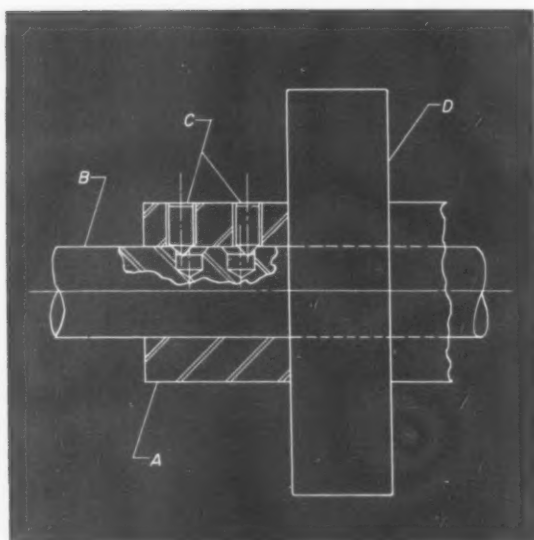
Flame-Plated coatings are applied by a series of controlled detonations using a specially constructed piece of equipment that resembles a machine gun. Oxygen and acetylene are fed into the chamber of the gun; then particles of fine coating powders are suspended in the gas mixture. When the mixture is ignited, a detonation takes place causing waves which travel through the barrel of the gun at supersonic velocities and heat the powder to a plastic state. The particles are hurled out of the barrel and embed themselves in the surface of the target work-piece, where a micro-

scopic welding action takes place. The resulting coating, which can be from 0.001 to 0.012 inch thick (applied in steps of 0.001 inch), is well-bonded, dense and hard.



Flame-Plating gun in action. Detonations of oxygen and acetylene mixture within the gun propel measured charges of white-hot (about 6000 degrees F.) molten powder at supersonic speed (about 1700 mph) against the surface of the target work at a rate of 4.3 cycles per second.

SHOP KINKS



Positive-locking shaft collar that has a fine adjustment for axial position.

lock such members in a positive position and yet permit fine adjustment for location and wear is here illustrated. These functions are achieved without close-tolerance shoulders, special nuts, or other expensive components or machining.

The collar is made of hardened steel and has a center hole sized for a slip fit on the shaft *B*. Two drilled and tapped cross-holes receive ordinary cone-point set-screws *C*. In addition, two shallow holes having the same diameter as the outside diameter of the screw are drilled in the shaft and chamfered to match the set-screw points. The center-to-center distance of the holes in the shaft is made somewhat less than that of the screws.

In use, the loosening of one screw and the tightening of the other will move the collar in one direction or the other, depending on which screw is loosened. When the collar is at its desired position, both screws are tightened, thus locking the collar on the shaft and positioning the rotating member *D*.

Adjustable-Position Shaft Collar

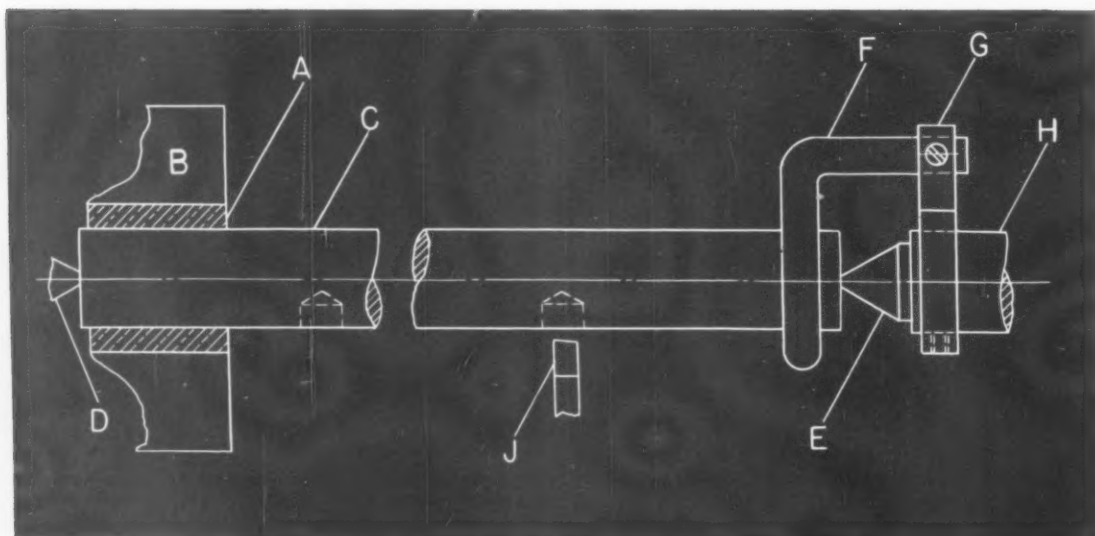
ROGER ISETTS, Kenosha, Wis.

Cams, pulleys, spacers, gears, or other rotating members must often be accurately located axially on shafts. A simply designed collar that can

Keyways Cut on a Lathe

FRANK L. RUSH

In an emergency, keyways can be machined in shafts that are held between centers in the lathe. In the method here illustrated, the cutter



Setup for cutting keyways in a shaft that is supported between centers on a lathe.

is mounted on the carriage and moved parallel to the horizontal axis of the lathe by the longitudinal power feed.

Bushing *A* is a piece of brass or bronze bar stock that has been secured in a lathe chuck *B* and bored to a running fit with the shaft *C* requiring the keyway. The shaft is placed between the lathe centers *D* and *E*, and a dog *F* is attached to the end of the work which is in contact with the dead center *E*. The dog, in turn, is restrained by a yoke *G*, which is clamped on the tailstock spindle *H* of the lathe. Lubricant must be applied to

both the dead and live centers and the bushing.

To cut a keyway, the lathe spindle is engaged and the depth of cut is set. This is done by inserting the cutting tool *J* into one of two holes that have been previously drilled in the shaft at the extremes of the proposed keyway. Then, the carriage feed is engaged, and when the tool reaches the second hole (at the other end of the keyway) the power feed is disengaged. Repeated cuts are taken until the keyway is machined to the required depth. A slow carriage feed should be used.

Handy Sine Layout Plate

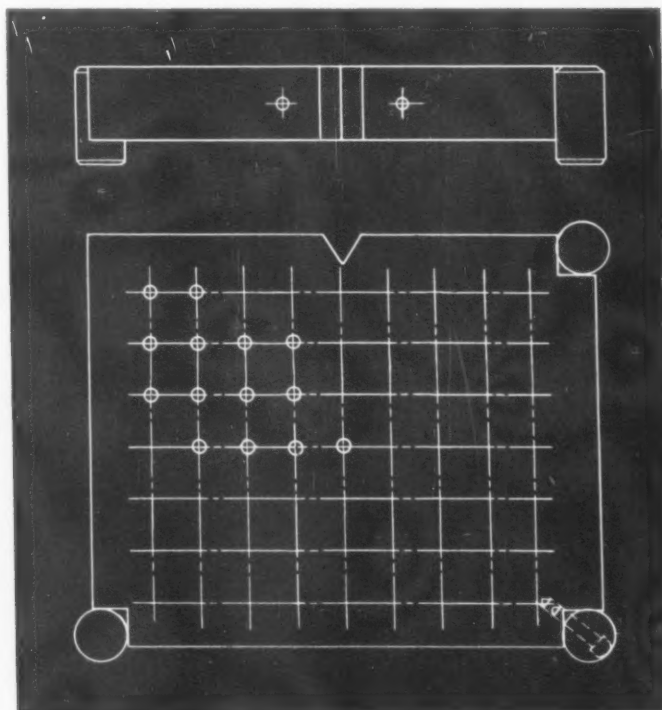
WILLIAM DE GROAT, Altadena, Calif.

A layout plate incorporating the features of a sine bar on two sides is here illustrated. Workpieces can be fastened to the plate and precise angles laid out from either the horizontal or vertical plane without changing the setup. This plate can also be used as a fixture for precision machining, grinding, or the accurate location of holes.

A V-groove is machined and ground in the top side of the plate to accommodate round work. Such parts can be held by straps secured by screws in tapped holes on either side of the groove. The original plate, made of cold-rolled

steel, was normalized and pack-hardened to minimize the possibility of dimensional changes after final grinding. Holes were drilled and tapped for 10-32 screws on 1/2-inch centers to facilitate strapping work to the plate, and similarly tapped holes were provided on each side of the V-groove. The rolls extend beyond the front face of the plate to insure its stability when used in an upright position, and are flush or recessed on the back face to present a flat surface when the plate is used in the horizontal position. Each roll is fastened to the layout plate by a cap-screw, counterbored below the bearing surface.

Sine layout plate that is convenient for scribing precise angles measured from either of two reference sides.



Missile-fuel control begins with precise machining

(Continued from page 85)

bles. When the work-piece on the table is in the proper position for drilling, a pin aligned with the machine spindle enters a hole in a master plate mounted below the movable subassembly of the table. This locks the part in position for drilling.

Table movement is made easy by an air lifting arrangement and antifriction bearings. Two holes in the part shown set up on the table are center-drilled, drilled (0.368 inch), and tapped with a 7/16-14 size spiral type tap. The machine illustrated is equipped with two working-positioning tables. One (top table) can accommodate master plates for any pattern of holes falling within a 6-inch diameter circle, and the second (lower table) can accommodate any pattern within a 15- by 20-inch rectangle.

Cleaning of Liquid-Oxygen Valves Is Vital

Because liquid oxygen will explode when it comes into contact with minute quantities of hydrocarbons, the cleaning, assembly, and testing of valves for use in this service are operations requiring extreme precautions. All parts are cleaned to exacting standards and assembled and tested in clean rooms pressurized with filtered air. After a precleaning by vapor degreasing, valve components are processed in the company's liquid-oxygen valve assembly room, using the Bendix ultrasonic cleaning machine seen in the background of Fig. 11. This equipment has five sections consisting of (1) a heater and filter unit for the cleaning fluid, (2) a power source, (3) the ultrasonic cleaning tank, (4) a water-rinse tank, and (5) a heated-air drying unit. Liquid-oxygen valve parts in accessible areas are tested with black light to determine the presence of fluorescent hydrocarbons. In another more universal test, the cleaned valve parts are first immersed in and flushed with acetone-free alcohol or distilled water. The parts are then removed and a sample of the solution is passed through a piece of millipore filter paper of 45-micron pore size. A vacuum is used to draw the liquid through the filter.

The filter medium, which is inscribed with a grid, is then placed under a microscope and a check is made of a specific size area to determine the maximum particle size. The limiting size for acceptance is usually 100 microns, but this will vary according to the particular specifications for the valve. To prevent contamination of these parts after cleaning, lint-free gloves are used by assemblers and the completed valves are sealed in polyethylene bags. In Fig. 12, a ball valve for controlling a cryogenic fuel in a military test-stand application is seen being checked for the presence of external leakage by means of a mass spectrometer.

Dual-propellant valves for the manned spacecraft X-15 (Fig. 13), which are assembled and tested in this manner, represent the first practical valve developed for metering cryogenic fuels to a rocket engine and are the only control the pilot has over his engine. Slightest leakage of these valves when closed could cause an explosion destroying the spacecraft.

Production of cryogenic valves also involves other problems. For example, in the assembly of ball valves for Pratt & Whitney Aircraft's liquid-hydrogen engine (see Fig. 14) Invar spacers are required in bolting arrangements to compensate for the differential in thermal expansion between the bolts and the retainer plates. Cleaning of the Nova valves was another problem because their size required that the operation be done by hand. Testing of these valves for reliability involved a cycling of each valve 1500 times under power.

An unusual operation performed by the company was the machining (Fig. 15) of a spent-uranium spherical casting to produce a valve to be used as a means of safely handling reactor fuel elements at the Enrico Fermi atomic power plant. The respirator was necessary to protect the machinist from the toxic fumes produced in cutting. In addition, the operation required sharp tools and slow cutting speeds to prevent the chips from igniting. The uranium ball member—which was more expensive than gold, ounce for ounce—weighed 300 pounds when finished.

Hydraulics Conference Held for Fabricating Machinery Industry

IMPROVEMENT in hydraulic products, system design, and maintenance methods was sought through open discussions between representatives of fabricating machinery users, builders, and accessory suppliers at the Fourth Fabricating Machinery Hydraulics Conference held in Detroit, Mich. Also taking part were engineering and service personnel of the sponsoring company, Vickers Incorporated, division of Sperry Rand Corporation. More than 150 persons attended the two-day gathering at the Sheraton-Cadillac Hotel on May 16 and 17.

Moderating the discussion group were Uel P. Jennings, development supervisor, Mechanical Development Laboratory, E. I. duPont de Nemours & Co., Inc., in Wilmington, Del., and David J. Sloane, vice-president of the Lester Engineering Co., in Cleveland, Ohio.

Seven technical papers were presented in the two-day period. Included among these were "Electro-Hydraulic Control in Paper Lamination," by Eugene Stewart of Carton & Container Division, General Foods Corporation; "Hydraulics Applied to Blow Molding Machinery," by Lloyd Kovacs, Waldron-Hartig Division, Midland-Ross Corporation; "High-Speed Electro-Hydraulic Servo for Turret Punch Press and Gauge," by Walton Rainey, chief engineer, Wiedemann Machine Co.; and "Fluid Motor Applications and Circuit Tips," by Orville Johnson, development engineer, E. I. duPont de Nemours & Co., Inc.

Of great interest to all attending were the many open discussion periods during which information was freely exchanged on current hydraulic problems. This discussion fell into five categories: valves, pumps, circuits and systems, maintenance and training, and fluids.

A question falling in the first group dealt with the possible increase in demand for air-pilot-operated four-way valves. In reply, Jack Carpen-

ter stated that, as far as Vickers can determine, such valves are still limited, in a great degree, to specialized applications. Following this, W. A. Stutske of the Kimble Glass Co. expressed his feeling that the glass industry has a real need for this valve. He went on, "Our industry is peculiar because a lot of our basic equipment is air-operated, and we are gradually incorporating . . . hydraulically operated machines and other devices which must be timed, perhaps, from an air-operated piece of machinery."

In the category of circuits and systems, a question delved into some of the best ways of maintaining proper fluid temperatures to avoid overheating. Warren Brown of Vickers led off the reply with a reminder that JIC specifies a maximum oil temperature of 130 degree F. It was felt that better circuit design was the answer to this problem. "Whatever causes resistance to fluid flow results in a pressure drop, or loss in energy, and adds heat to the system." As a dramatic illustration, a circuit was pointed out in which only 1 hp was being converted into heat. However, the single horsepower equals 42.4 Btu per minute. "This means that in eight hours you have added 20,300 Btu to the system." Assuming no losses, this is enough heat " . . . to raise the temperature of 20 gallons of oil 340 degrees F."

On the subject of fluids, it was asked whether information was available with regard to improvement in the life of vane type pumps when filters incorporating magnets were used. In answer, Don Fornell of Vickers said that filters of this type were relatively new, that they have not been used as widely as magnetic bar and plug assemblies placed in the hydraulic reservoir. Although conclusive data covering the use of filters incorporating magnets have not been received, a number of reports indicate that this combination is doing an effective job of removing ferrous particles.

Moderators of the Fourth Fabricating Machinery Hydraulics Conference were Uel P. Jennings, development supervisor, Mechanical Development Laboratory, E. I. duPont de Nemours & Co., Inc. (left), and David J. Sloane, vice-president of Lester Engineering Co. (right).



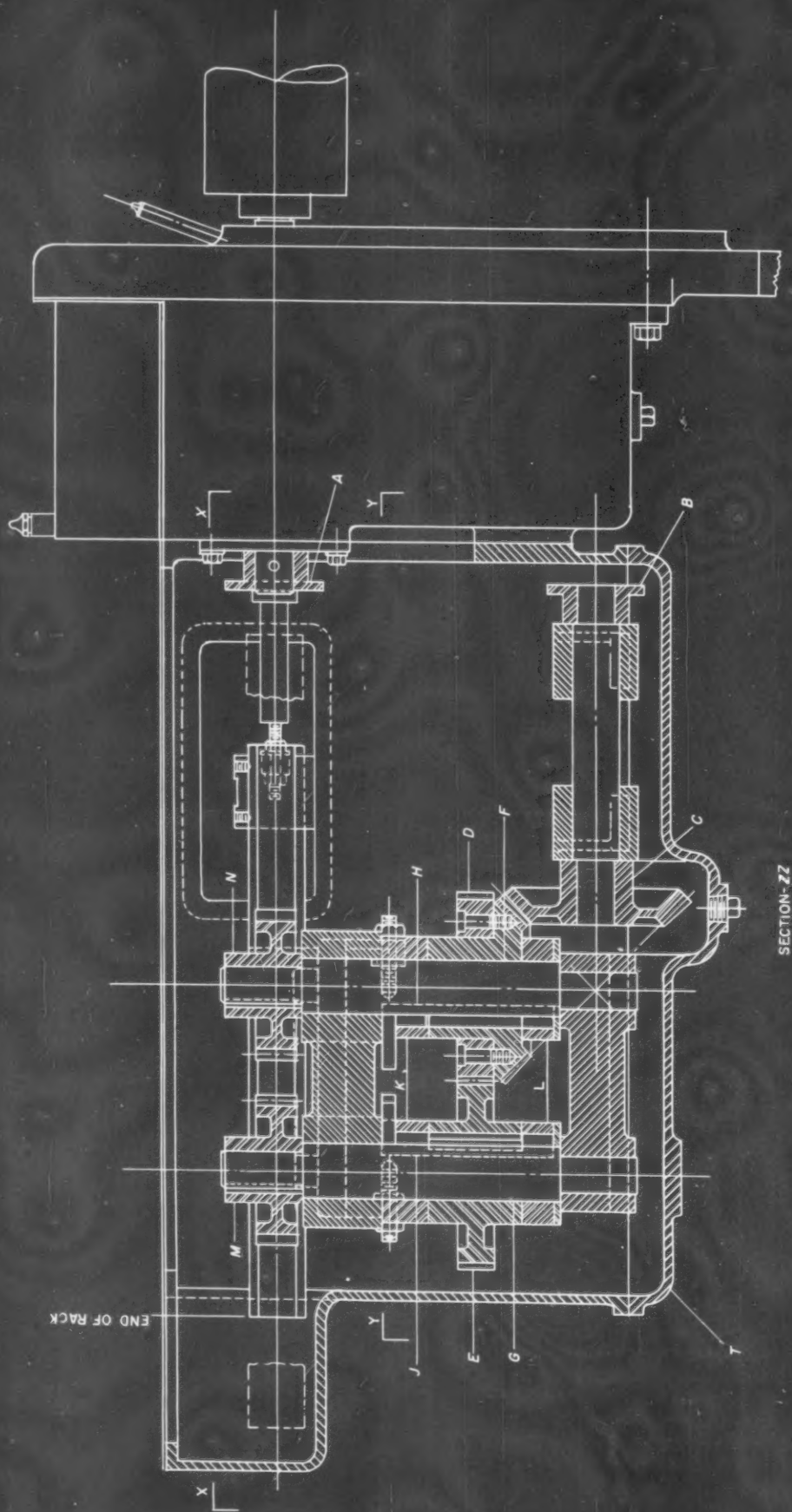
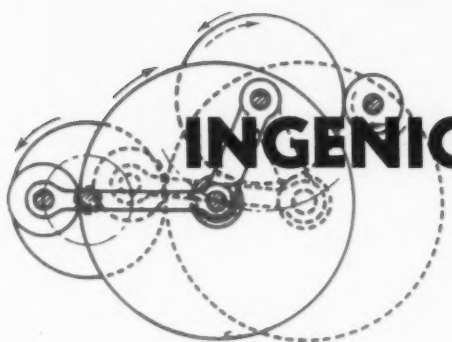


Fig. 1. View of thread-guide traversing mechanism shows design of the pinion-clutching arrangement on shafts (M) and (J).



INGENIOUS MECHANISMS

Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

Instantaneous Reversing Shaft-Traversing Device Replaces Troublesome Cam

ARTHUR MEDER, Allendale, N. J.

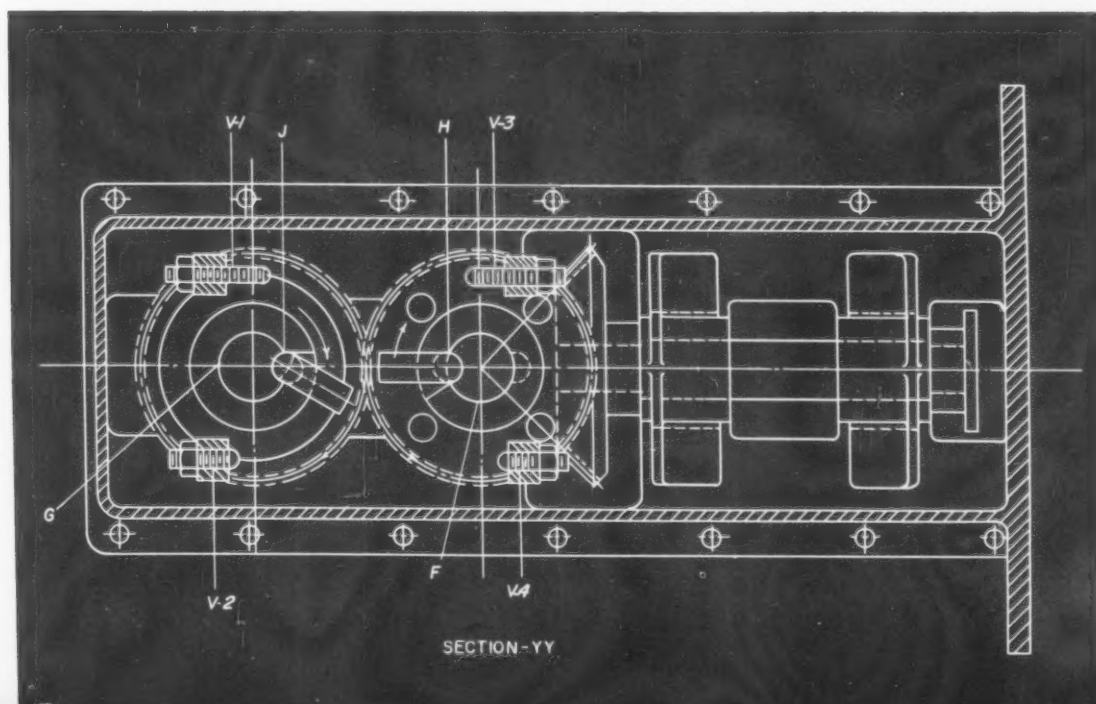
A "cheeser-twister" in the textile industry is a yarn-winding machine. The machine puts the twist in yarn as it comes from the spinning machine, then winds it (zigzag, like twine) on a cylindrical cardboard core about 5 inches long, making a rough ball about 5 inches in diameter. The balled yarn is called cheese.

It is important that tension of the yarn in the cheese be uniform and without slack because slackness results in a loose warp thread when the yarn has been woven into cloth. Wear on the drum cam causes the follower and, through it, the

thread-guide traverse to dwell at the end of a stroke instead of reversing direction immediately. During the dwell the yarn builds up unevenly on the edges as undesirable slack, that causes loose warp threads.

The writer has designed, and put into the cheeser-twisters at his plant, a traverse mechanism that eliminates the drum cam and its problem of wear. The new traverse therefore provides reliable yarn-tension control, and reduces machine down time and the cost of repairing and replacing worn cams. Also productivity is up.

Fig. 2. Alternate clutching of pinions (G) and (F) is created by levers on pins (J) and (H) striking stops (V-1) and (V-2), and (V-3) and (V-4), respectively. (Note Section Y-Y, Fig. 1.)



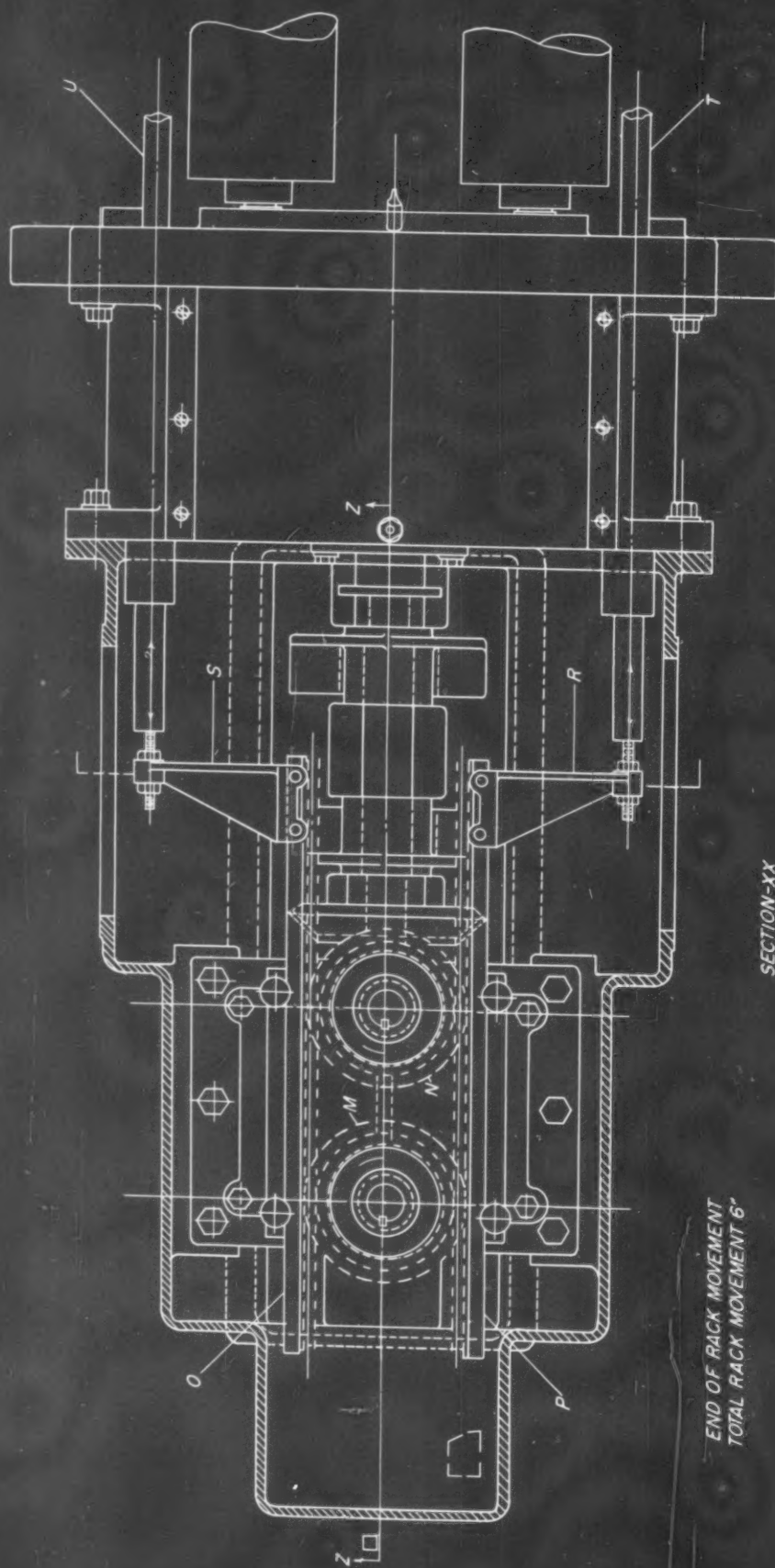


Fig. 3. Section through the shaft-traversing mechanism shows how brackets (R) and (S) transmit motion from racks (O) and (P) to the yarn guide-shaft traverse bars (T) and (U), respectively.

In Fig. 1 is shown a cross-section assembly of the new traverse on the cheeser-twister. The cam-shaft has been shortened to provide for a driving sprocket A which transmits the power to the mechanism through the sprocket B by a roller chain.

The principle of the design is a parallel rack movement with alternative driving pinions mounted between the racks. The rotation of each pinion causes one rack to advance and the other to retract, thus creating a balanced motion in the machine.

Bevel gear C drives gears D and E which are free to rotate on shafts F and G. On the ends of the shafts, rack pinions M and N are keyed and always in mesh with the racks O and P (Section X-X, Fig. 3).

Each of these shafts is fitted with round clutch keys H and J, each having half the diameter cut away as shown in Fig. 2, Section Y-Y, and full-diameter bearings in the collars K and L, shown in Section Z-Z.

The length cut away from the clutch keys is the length of the hub on gears D and E. The keys each have one end bent up at right angles to the diameter, providing a means for lever action to rotate them, when contacted by adjustable stop-screws V-1, V-2, V-3 and V-4. Thus, the rotating motion of the key serves as a clutch.

Each rack has a bracket fastened to it for the

purpose of moving the traverse bars T and U, Section X-X, Fig. 3.

In the operation of this mechanism, as shown in Section Y-Y, (Fig. 1) one key J is positive, while the other H is neutral. In this case, shaft G is a positive drive through gear E. At the same time shaft F is driven through the rack pinion N in mesh with racks O and P. Reverse rotation of shaft F turns it back to the starting point, when the lever end of the key H is rotated into positive position by stop-screw 3, to do the driving via gear D. At the same time key J has been rotated into neutral position by stop-screw 2, and shaft G backed up to the starting point. Gears D and E are individual drivers, due to the clutch action of the key, in mesh with one another and always rotating in the same direction.

The pinion gears M and N are not in mesh with each other and turn one-half revolution in the same direction, being in mesh with the racks O and P, which produces the reciprocating motion of the traverse bar.

The gears D and E make one-half to one revolution forward and one-half revolution in reversing gears M and N. Hardened chrome-alloy steel is used for the racks, gears, shafts, and keys.

The top of the case is covered with transparent plastic to permit inspection. The bottom has a removable castiron cover which supports the shaft bearings.

Metal Protection Methods Aired

Corrosion problems and means of protecting materials from the corrosive effects of sea water and the atmosphere were discussed at the recent meeting of the Sea Horse Institute held at Wrightsville Beach, N. C. These discussions are sponsored annually by the International Nickel Co., Inc., New York City. The eight sessions of the meeting, which required four days to complete, were attended by over 250 engineers, scientists, editors, and other representatives from government establishments and private industry.

One important topic under investigation involved the corrosion of materials used in the construction of equipment for the large-scale conversion of sea water to fresh water. Other discussions concerned the effect of minor alloying additions to carbon steel in reducing pitting attack due to sea-water exposure; what new alloys have been developed for marine applications; what materials are subject to stress-corrosion cracking in marine atmospheres; the effectiveness of various protective coatings for metal immersed in sea

water; and developments in cathodic protection.

Informal conferences and inspection of selected experiments at both the sea-water immersion test station at Harbor Island, N. C., and the atmospheric exposure test station at Kure Beach, N. C., were included as part of the agenda. Future research at the institute was also discussed.

New Norden Research Plant

A multi-million-dollar facility dedicated to engineering-research and manufacturing of electronic and electromechanical systems and components has been placed in operation by the Norden division of United Aircraft Corporation. Located on an 80-acre tract in Norwalk, Conn., the new plant has a working area of 350,000 square feet and consolidates departments previously situated at three separate installations. In addition to advanced electronic and mechanical engineering laboratories, a well-equipped machine shop and dust-free rooms for assembly of extremely sensitive gyroscopic instruments are features of the facility. A private heliport is located within the grounds convenient to the main lobby of the building.

Modernization—Keynote of Machine Tool Builders' Meeting

Virtually all of the speeches made by high government officials at the fifty-ninth spring meeting of the National Machine Tool Builders' Association stressed the keen desire of the Kennedy Administration to promote the modernization of America's industrial plants. Emphasis was laid on the fact that Western Europe and Japan are outstripping us productively in many areas and that this trend must be rectified. The meeting was held at the Mayflower Hotel, Washington, D. C., on June 1.

The same keynote ran through the address of Everett M. Hicks, president of the association and vice-president and general manager of the machine tool division of the Norton Co. Mr. Hicks pointed out that the challenge to our country, and in fact to the free world, is to increase our productivity as rapidly as possible. He referred to a report on machine tools recently released by the Bureau of Defense and Services Administration which stated, "By 1955, the United States had lost its leadership as a world supplier to West Germany and has since continued to rank second to that country . . . Although the United States is a net exporter by a wide margin, imports have increased substantially in recent years."

Mr. Hicks continued, "The United States (1) leads the world in the development of machine tools; (2) is supplying a dwindling percentage of machine tools to world markets; (3) has more obsolete machine tools now than at any time since the 1930's; (4) is utilizing only a fraction of its machine tool producing capacity while other nations are operating at full capacity with large backlogs; (5) permits the lowest rate of depreciation for new investment of any of the eight major free-world industrial nations."

Mr. Hicks also pointed out that the Administration has proposed a form of incentive taxation to stimulate investment in durable equipment and that it has indicated that it plans a tax revision next year, with a loosening of our depreciation strait jacket and other incentives to stimulate capital formation and investment in new plant and equipment. He then raised the question as to whether the Administration was "making the mistake of taking medicine to relieve our symptoms without having made a thorough diagnosis of the disease?" He emphasized the point that at a time when our industry and many others are losing their ability to compete in the world mar-

kets because of high costs, it would seem desirable to diagnose carefully the reasons for these high costs if we are to find the cure. He observed that if we are to attain low costs, we must not only modernize our equipment but, equally important, we must find a way to stop our inflation, giving the other countries of the free world a chance to catch up with us costwise so that we can again compete in the markets of the world.

Mr. Hicks further commented, "Aid for education, medical care for elderly people, probable increases in pensions, more help for farmers, bigger subsidies for airport building, special aid to Latin America, assistance to depressed areas—all of these and other programs under consideration mean increased spending by Government, and this will inevitably mean a revival of inflationary pressure."

"While most of these programs appear desirable when considered individually, isn't it time we reviewed this from an over-all standpoint and decided, in view of world-wide competitive pressures, we cannot afford to go further toward a welfare state?"

"Gentlemen, in my opinion, our biggest danger is not that the Communists will defeat us, but that we will defeat ourselves by socialistic programs designed to attract votes and to satisfy demands of various minority groups. . . . It's time we awakened to the fact we are not living in isolation. If we are to survive, we must compete; and if we are to compete, we must be efficient and have low costs."

In his address, Joseph S. Imirie, assistant secretary of the Air Force (Materiel), stated: "As scientific research affects technological progress, so machine tool manufacturing affects industrial progress. More than any other segment of industry, you and your associates will determine how well the nation can convert knowledge into hardware—for the defense of the nation as well as for our economic growth."

Mr. Imirie stated that the practice of the Air Force is to modernize its tool inventory as rapidly as practicable. He said that the Air Force was not interested solely in buying newer tools, but rather higher-performing tools that are more efficient and more adapted to materials demanded in the manufacture of aerospace weapon systems and support equipment.

The philosophy back of the Air Force program is to accomplish four manufacturing goals: to

reduce tooling costs, to eliminate the human error factor, to assure exact repeatability, and to minimize machine variables. The over-all idea, of course, is to guarantee design integrity when specifications are converted to material configurations. At the same time, it is the desire to dispose of obsolete tools and reduce the total tool inventory. The aim is to de-emphasize special-purpose machines and concentrate on machines that have multiple-use capabilities. A program is in effect that would, on the average, replace 2000 existing tools with 500 modern machines.

Hickman Price, assistant secretary for Domestic Affairs, Department of Commerce, asserted that since World War II Europe and Japan have actually effected another Industrial Revolution that challenged our former industrial superiority. In addition to money, we supplied a vast amount of technical know-how. He stressed the fact that modernization of American industry is our biggest job over the next five years.

Mortimer M. Caplin, commissioner of Internal Revenue, discussed current depreciation problems and particularly the tax-incentive plans suggested to Congress. Frank B. Ellis, director of the Office of Civil Defense Mobilization, called the modernization of production equipment the key to national defense.

Harold F. Linder, president of the Export-Import Bank of Washington, stated that the bank's lending programs probably affect machine tool builders and the users of machine tools more than any other industrial group. That is because almost all operations in overseas lending result in the purchase of United States capital equipment of many kinds and items for industrial use. A machine tool, its use, or the products of its use are inevitably involved.

In twenty-seven years of operations, the bank has authorized over \$11,000,000,000 to assist United States export trade. The program of the

bank is designed to stimulate United States exports by lending the foreign buyer the dollars with which to pay for his order.

John E. Horne, administrator of the Small Business Administration, discussed "Small Business and the Future." He stated that the "Administration has set in motion a vast program designed to produce a satisfactory rate of economic growth, rapid plant modernization, and price stability. Doubtless, we all agree that these goals are desirable, and many of us would say that their achievement is essential if this nation is to emerge victorious in the world-wide struggle we are engaged in. But what many fail to understand is that there are no bargain rates, no short cuts, no easy paths to their attainment. What is required is a renewed dedication—on the part of both Government and business—to the basic aims of our democracy, a sense of urgency, and a determination to get the job done at whatever cost."

Mr. Horne reiterated that modern machine tools are the father of mass production and that machine tools make possible more goods for more people at lower cost. Historically no nation on earth has done more to bring the benefits of mass production to its people than has this country. But he said that it does no good to point contentedly to the past and to adopt the complacent view that just because America has historically been a world leader in mass production that it will always remain so. The fact is that America's supremacy in the past has been achieved by hard work, initiative, and innovation, and we are going to have to reassert these qualities more vigorously than ever before if we expect to hold a position of leadership in the future as we have in the past.

The final speaker of the meeting was James Cooley, special assistant to the director of International Cooperation Administration, who made the prediction that the sixties would be a decade of development.

Gathering of the Past Presidents' Council of the National Machine Tool Builders' Association at its fifty-ninth spring meeting. The five most recent past presidents are, from left to right, Alfred V. Bodine, president and treasurer of the Bodine Corporation; Louis F. Polk, chairman of the Sheffield Corporation; Jerome A. Raterman, chairman and president of the Monarch Machine Tool Co.; Ralph J. Kraut, president and general manager, Giddings & Lewis Machine Tool Co.; and Alan C. Mattison, president, Mattison Machine Works. Mr. Polk is chairman of the Past Presidents' Council.



NEW DEVELOPMENTS IN

Machine tools, unit mechanisms, machine parts, and

Special Transfer Machine for Processing Automotive Clutch Housings

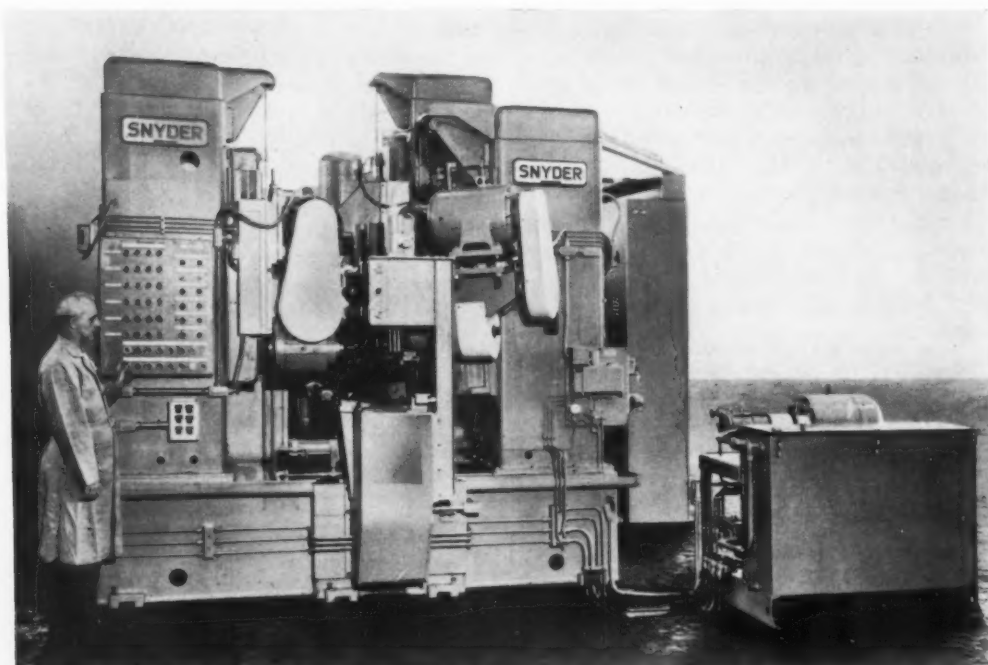
A special thirteen-station segmented transfer machine that mills, orients, drills, chamfers, reams, and taps 150 cast-iron automotive clutch housings per hour at 100 per cent efficiency has been built by the Snyder Corporation, Detroit, Mich. A unique feature of this 26 1/2-foot long three-section machine is the design of the work-fixtures of the five machining stations. The parts are moved from station to station by a pawl type rotating-bar transfer mechanism.

This mechanism slides the parts on rails. The clutch housings are gripped from the inside in the work-fixtures with clamps that bear on the top of a concealed flange.

To permit lowering the jaws after machining so that the part is free to slide on the transfer rails between stations, a work-fixture was developed which has disappearing jaws. The jaw in each fixture is a one-piece detail that bears on three points on the con-

cealed housing flange. It is operated by double eccentrics actuated by a hydraulic cylinder through a rack and pinion drive and a gear train. Thus, the jaw can raise, travel sideways, and lower to clamp the part; and then raise, move sideways, and lower into the fixture to clear the part for the transfer operation.

The operator places the part on the transfer rails in Station No. 1. At the second station, a column-mounted way type machining unit



Snyder transfer machine that mills, orients, drills, chamfers, reams, and taps automotive clutch housings

SHOP EQUIPMENT

material-handling appliances recently introduced

on one side of the transfer line mills the top of two mounting bosses. This unit is synchronized with the transfer mechanism so that it returns with it. A column-mounted way type slide unit on the opposite side of the line has a drill head that covers both Stations Nos. 5 and 6. At Station No. 5, four holes are drilled and chamfered with combination tools, while two other holes are drilled and spot-faced with combination tools. Four holes are reamed with the same head at the sixth station, while another angular hole is drilled with a single-spindle unit.

At Station No. 6, on the opposite side of the line, two holes are drilled by one unit while another drills an angular hole. The seventh and eighth stations are idle. Two drilling units of one side of the line at Station No. 9 chamfer two regular holes and an angular hole. A drilling unit on the opposite side of the line at this station chamfers the other angular hole. Stations Nos. 10 and 11 are idle.

Two drilling units on one side of the line at Station No. 12 tap two holes and an angular hole. Three other drilling units on the opposite side of the line at Station No. 12 tap two vertical holes, ream a horizontal hole, and tap an angular hole. The finished part is unloaded at Station No. 13.

Snyder standard bases, columns, and machining units are utilized in the design, along with standardized drilling units. The clutch-housing transfer machine is hydraulically operated and electrically controlled.

Circle 565 on Readers' Service Card



Airco welding gun designed especially for thin-gage ferrous metal

Air-Cooled Manual Gun for Welding Thin-Gage Metals

A low-cost, air-cooled welding gun, designed specifically for the gas-shielded metal-arc welding of thin-gage ferrous metals, has just been announced by Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City. This Model AH30-A gun is designed for applications requiring ruggedness, high-duty cycles, and a minimum of down time, qualities especially appropriate to the automotive industry and most other fabricators of mild steel. It is said to be ideal for welding steel with the dip-transfer process.

The gun's 60-degree gooseneck

design and light weight permit access to normally hard-to-get-at places and lessen operator strain from welding in difficult positions. It uses 0.035- and 0.045-inch diameter steel wires in combination with a variety of wire feeders.

The gun is rated at 300-ampere direct current, reverse polarity, 100 per cent duty cycle for CO₂ buried-arc process; and 200-ampere direct current, reverse polarity, 100 per cent duty cycle for Aircomatic welding with spray transfer.

Circle 566 on Readers' Service Card

Ram and Turret Milling Machine

The Index Machine Co., Jackson, Mich., announces a ram and turret mill, Model No. 645, designed for toolroom use or production runs. The new vertical milling machine has a head that tilts 45 degrees forward and back and rotates 360 degrees on the ram. The turret also rotates 360 degrees on the column and, in addition, the power assembly rotates 360 degrees around the spindle. These features, plus 18-inch knee travel and 25 1/2-inch overarm travel, simplify setups and provide for quick setting of any compound work-angle. According to the company, the range of the machine is much greater than normally expected of machines in its price class.

The distance from spindle to table can be adjusted from 0 minimum to 19 1/2 inches maximum. The distance range from the center line of the spindle to the column ways, with the spindle in a

vertical position, is 1 1/2 to 27 1/4 inches. Similarly, the distance from spindle to column ways can vary from 0, with the spindle tilted back 45 degrees, to 31 1/2 inches with the spindle tilted forward. Cross travel of the table is 10 inches (12 inches as an extra), with a longitudinal travel of 26 inches on the standard 9- by 40-inch table (32 inches on the 9- by 46-inch table). The spindle has a vertical travel of 5 inches. Nine spindle speeds are provided with the standard 1-hp motor, and there are three spindle feeds with adjustable depth, power feed up as well as down.

Tapered gibs, hand-scraped bearing surfaces, ground lead-screws, large quill, hardened and ground spindle running in super-precision preloaded ball bearings, plus an overarm that stays in one plane and locks without distortion are provided for greater accuracy.

Extras available include: 46-inch table, longitudinal power feed with eight speed changes obtainable without reducing table movement, chromium-plated ways, coolant system, riser blocks to increase distance from spindle nose to table, slotter, verniers, rods and indicators, optional locating system, and rapid traverse.

Circle 567 on Readers' Service Card

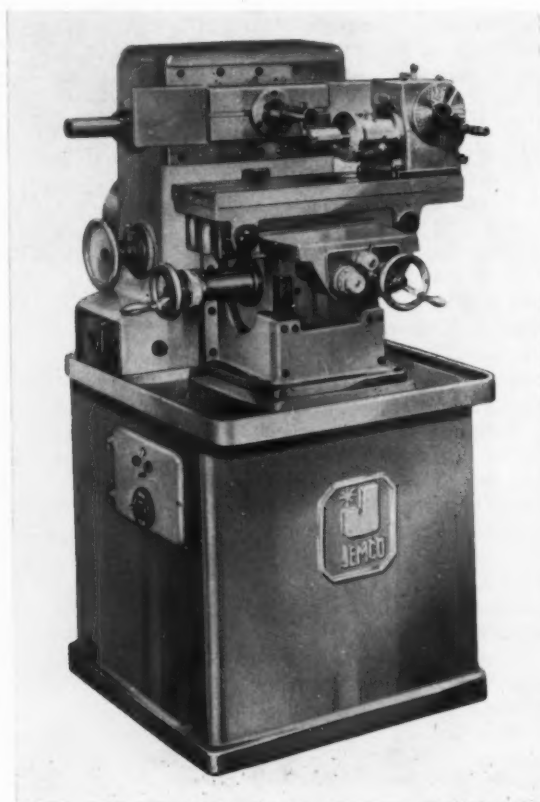
Form and Punch Shaper with Redesigned Table Top

The Jersey Mfg. Co., Elizabeth, N. J., has recently redesigned the table top of its K-15 form and punch shaper so that it is now possible to tilt the work-piece to

as much as 25 degrees upward and to a maximum 10-degree swing downward. The tables of these machines previously had no vertical angular adjustment. All



Tilting-head milling machine built by Index Machine Co.



Improved form and punch shaper built by Jersey Mfg. Co.

the revolutionary and unusual features of the original design remain intact.

This K-15 form and punch shaper will machine the entire work-piece, automatically, in one setting without necessitating re-clamping. It machines tapered punches as well as countless contours and angular radii, all within a guaranteed accuracy tolerance of plus or minus 0.00025 inch. For strict optical control over each operation, a projector mounted on the machine magnifies the work-piece twenty times. The K-15 has speeds of 50, 75, and 110 strokes per minute, with an adjustable length of stroke of 0 to 6 inches and a working area of up to 6 by 6 1/4 inches.

Circle 568 on Readers' Service Card

Machine for Boring Clutch Component

The Ex-Cell-O Corporation, Detroit, Mich., recently completed a two-spindle, cam-operated precision boring machine, Model 312 (Fig. 1), capable of generating a total of twenty-one different surfaces in one operation on a cast-iron clutch component. It often happens that the accuracy of the form of a work-piece must be held to closer tolerances than is possible by using conventional plunge-form tools or radius and grooving tools. Under these circumstances, it becomes necessary to generate those surfaces with single-point tools, guided by an accurate master. Such is the function of this Ex-Cell-O cam machine.

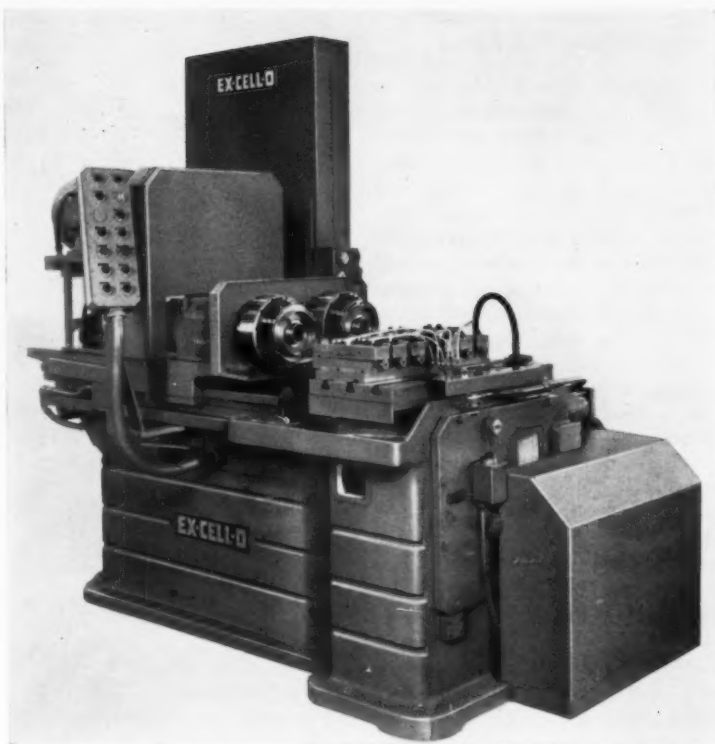


Fig. 1. Cam-operated Model 312 Ex-Cell-O precision boring machine equipped to produce cast-iron clutch components

In operation two parts are manually loaded. The table rapid-traverses to the left and tools No. 1 (Fig. 2) generate the chamfer *A*, bore diameter *B*, and generate the bottom radius *C*. After rapid traverse, the tools continue and generate chamfer *D* and bore diameter *E*. At the completion of this stroke, tools No. 2 are in close proximity to their starting positions and immediately gener-

ate surfaces *F* through *J*. Tools No. 2 having accomplished their cycle, tools No. 3 face surface *K*, generate radius *L*, taper *M*, turn *N*, chamfer *O*, and generate an accurate radius at *P*. All these individual cutting operations are performed in one rapid, continuous motion with unfailing accuracy and repeatability. Production is 100 parts per hour.

Circle 569 on Readers' Service Card

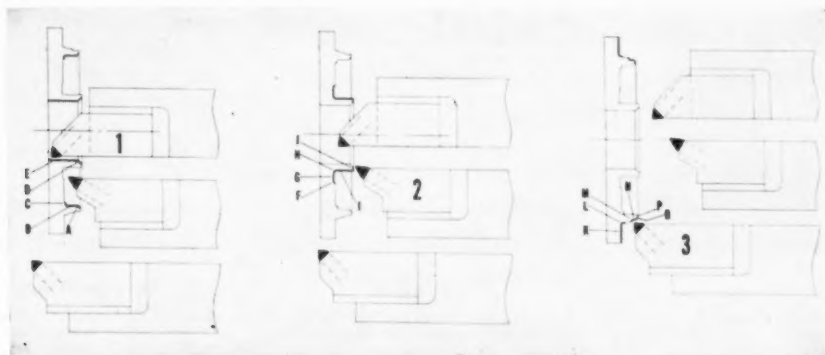


Fig. 2. Step-by-step operational procedure in processing cast-iron clutch component

Versatile Reed Thread-Rolling Machines

Design changes have been made in both of the heavy-duty Models A33A and A34A three cylindrical-die thread- and form-rolling machines made by the Reed Rolled Thread Die Co., Holden, Mass. These changes have increased the versatility of the machines as well as reduced the setup and change-over time required in their operation. The Reed three cylindrical-die through-feed principle of rolling is now possible in the A33A machine using dies with either parallel- or skewed-axis settings. Feeding of the work with parallel-axis dies (dies positioned parallel to axis of work—0-degree skew) is accomplished by using a greater lead angle on the dies than that of the thread or form to be rolled. With skewed-axis rolling, the axes of the dies are skewed between 0 and 5 degrees to provide for the feeding of the work. (See explanation of skewed-axis method, Fig. 2.)

The Model A33A machine is equipped with die-holders designed to accommodate a 4-inch width of die and permits the most economical selection of die face for through-feed rolling. Although the A33A machine can be equipped for infeed rolling, it is the machine usually selected where all of the work is to be handled by through-feed rolling or as a combination machine when there is a limited requirement for infeed rolling on work with thread and form lengths under 4 inches. The A33A machine



Fig. 1. Reed thread-rolling machine redesigned for greater versatility

is now equipped with a 40-hp motor and the gear-box has been redesigned to accommodate continuous through-feed rolling of thread and form diameters from 5/8 to 2 1/2 inches. Diameter capacity of the machine when used for infeed rolling is 3/4 to 2 1/2 inches. Heavy-duty 1 7/8- and 2 1/2-inch diameter spindle assemblies cover the full capacity range of the machine.

The Model A34A machine can accommodate 5-inch wide dies. Infeed capacity provides for rolling thread and form diameters from 3/4 to 4 inches and lengths up to 4 1/2 inches. The diameter capacity for through-feed rolling is 3/4 to 2 1/2 inches.

Die-holders for both the A33A and A34A machines have been completely redesigned. They now include removable front bearing supports. This allows changing or replacing the dies without removing the die-holders, as in previous models. Fig. 1 shows this design construction, which accounts for considerable reduction in setup and change-over time.

A wide selection of work-handling equipment is offered for use with these machines. This includes equipment suitable for manual, semi-automatic, and fully automatic operation or integrated in completely automated lines.

Circle 570 on Readers' Service Card

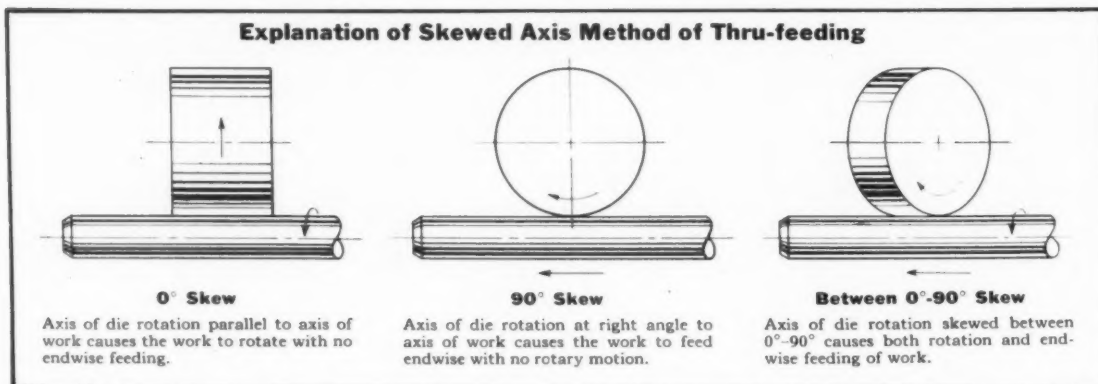


Fig. 2. Diagrams illustrating skewed axis-method of through-feeding on Reed machine, Fig. 1

Automatic Top-Loading Bar-Stock Feeder



Uni-Mac Bar Hopper feed for automatic machines handles mill-length bars

A unique method of loading bar stock from the working aisle over the machine, plus rapid operation, accommodation of mill-length bars, and versatility of application, combine to make the Uni-Mac "Bar Hopper" of considerable interest to the users of single-spindle screw machines, centerless grinders, thread rollers, and other equipment handling long bar stock. The Unit Machinery Co., Rockford, Ill., designer and builder of the Bar Hopper, has incorporated in this equipment many features developed during years of practical experience with screw machines.

The Bar Hopper is attached to the bar-feed end of the machine. It consists of a magazine of twelve telescoping tubes, slightly tapered in arrangement and carried in rotatable mountings at both ends. As a bar runs out in the machine, a new bar is automatically inserted from the magazine, this operation taking less than one second.

The magazine is loaded by inserting bars into the exposed tubes in the upper part of the magazine by feeding them in over the machine from the working aisle. Because no space is needed at the rear end of the bar feeder, and because bar stock can be stored beneath the Bar Hopper until needed, an appreciable amount of floor space can therefore be saved in planning a shop layout.

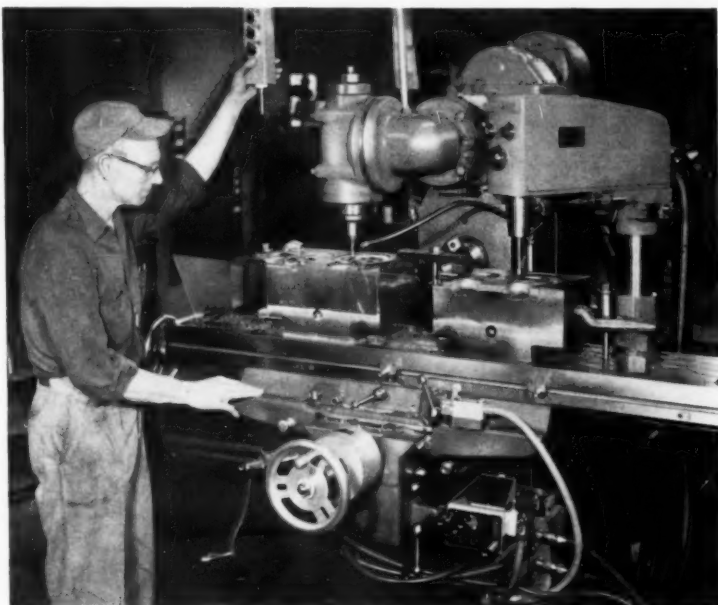
Each feed-tube has a telescop-

ing rear section which is automatically drawn up to compensate for variations in bar length of as much as 9 inches. This feature enables the shop owner to buy bar stock in mill-run length variations, instead of having to specify exact bar lengths, thus effecting a saving in material cost.

The Bar Hopper is 13 feet long and 16 inches wide. It is now made in two standard sizes, one with a maximum capacity for handling bars up to 1/2 inch in diameter, while the other takes bars up to 3/4 inch in diameter. Hexagons, squares, and other shapes can be handled as well as rounds.

Circle 571 on Readers' Service Card

Scan-O-Matic Miller Equipped for Rapid Duplication of Forging Dies

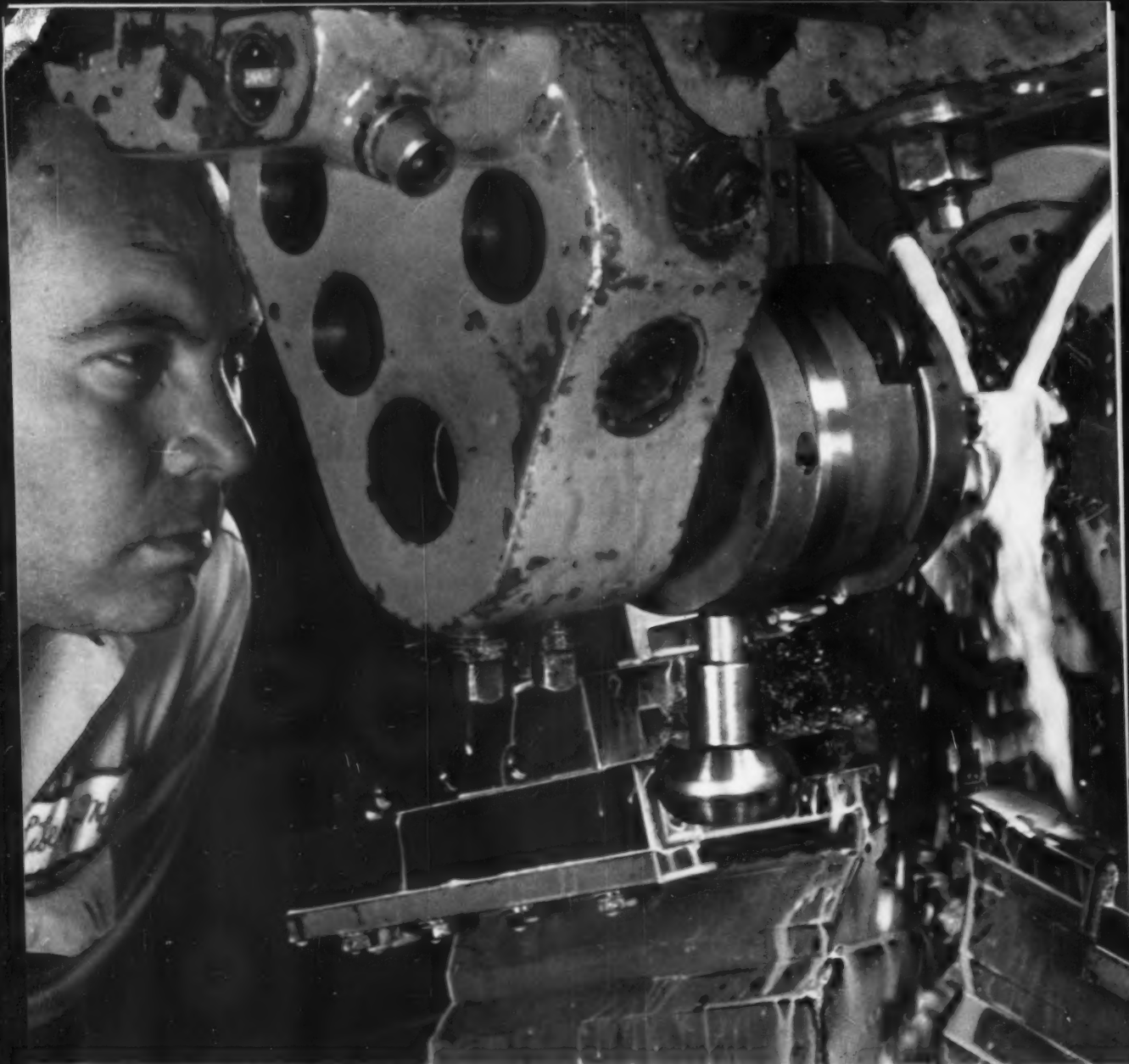


Greaves Scan-O-Matic miller speeds duplication of drop-forging dies

Rapid, accurate, and economical duplication of drop-forging dies used in the production of suspension hooks is being done on a Scan-O-Matic milling machine made by the Greaves Machine Tool Co., Cincinnati, Ohio. Duplication of one of these 10- by 14-inch dies of Heppenstall Hard Tem steel requires only a few hours' operation of the Scan-O-Matic miller, which is basically

a Model 2H plain Greaves milling machine equipped with a universal toolmaker's overarm and Scan-O-Matic duplicator.

In producing the finished die or duplicate of the master die-block, three sizes of ball type end mills held in the universal toolmaker's overarm are used. A 3-hp unit affords eight spindle speeds ranging from 175 to 1750 rpm. The spindle itself has a No. 50 standard taper



Thread rolling a sucker rod. The coolant: Gulfcut Heavy Duty Soluble Oil. It helps Liberty produce an unusually fine thread.

Change to Gulfcut® Heavy Duty Soluble saves thousands of dollars yearly...

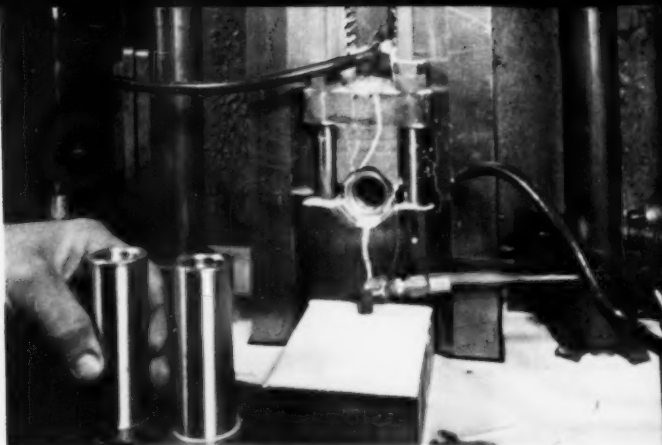
Liberty Manufacturing Company has a certain distinction in the oil industry. This Fort Worth, Texas, firm was the first to market ½-inch sucker rods—used in oil wells to actuate the pumps which bring oil to the surface.

Some months ago, the company switched from a chemical coolant to Gulfcut® Heavy Duty Soluble Oil—and eliminated a costly degreasing operation. Previously, degreasing was necessary before

sucker rods could receive a coat of protective paint.

"We use a ratio of 20 parts water to one part oil," says Mr. W. V. Barbee, Plant Superintendent. "The result: a light film of oil. It protects the rods against rust, yet isn't heavy enough to make us degrease before painting.

"We've benefited in other ways from the change-over. For instance, we haven't found one bit of rust in any machine-operated part. Paint peeling is no longer



Slotting a $\frac{5}{8}$ " couplet which fits on the end of a sucker rod. Gulfcut Heavy Duty Soluble Oil is the coolant.



W. V. Barbee, left, Plant Superintendent, and Frank Mauro, Gulf Sales Engineer. In background is stack of sucker rods.

Oil eliminates degreasing operation, GULF MAKES THINGS RUN BETTER!

a problem. And tool life seems to be much improved.

"Lastly, poorly rolled threads on sucker rod pins can lead to real trouble—broken joints out in the oilfields. But Gulfcut Heavy Duty Soluble Oil helps us get an almost perfect thread."

If you've got a tough machining problem, give us the opportunity to show you how Gulf makes things run better! Call a Gulf Sales Engineer at your nearest Gulf office. Or write for Gulfcut literature.

GULF OIL CORPORATION
Dept. DM, Gulf Building
Houston 2, Texas



—the same as the horizontal spindle—thus minimizing the cost of tooling in subsequent work.

Rough machining of the die-block to a depth of 1/4 inch is done with a 5/8-inch diameter ball end mill at a spindle speed of 640 rpm, feeding at a rate of 12 ipm through the hydraulic table. Pick feeding is at 1/32 inch on each pass of the table.

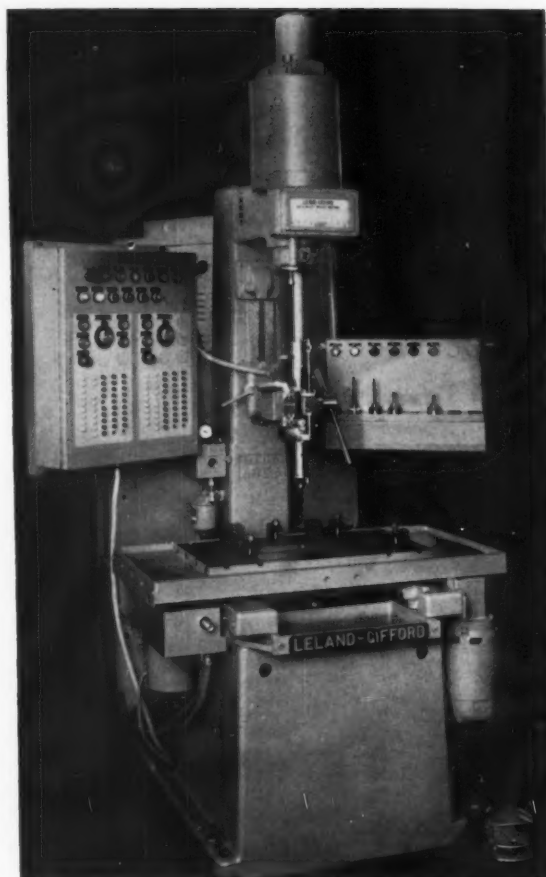
Finish machining is done with a 1/4-inch diameter ball end mill at a spindle speed of 800 rpm, cutting 1/16 inch deep while pick-feeding automatically 0.010 inch on each pass. Two pockets in the die-block required the use of a 3/16-inch diameter ball end mill running at 1200 rpm, at a depth of 1/16 inch, with the pick feed operating at 0.0025 inch on each pass. The tracing stylus is 0.015 inch larger than the cutter size.

As demonstrated by the application described, the Scan-O-Matic miller is fully automatic throughout a three-dimensional range, requiring a minimum of operator attention after setup. It can be set up to scan with either the table or saddle movement, with pick feeding being done by the opposite movement. Pick feeding by the Scan-O-Matic system is infinitely variable, being controlled by a needle valve and an electric interval timer. A hydraulic cylinder and constant-torque hydraulic motors control knee, table, and saddle movements.

Other features are: uniform rate of cutting feed regardless of shape or angle of model; constant stylus deflection for uniform, accurate cuts; automatic shutdown when predetermined programming has been completed; plateau control; an adjustable depth stop which can be set to regulate the depth of each consecutive cut; and a knee control for the sequence of the scanning cycle for internal or external work.

The standard Scan-O-Matic installation is arranged for semiautomatic profiling. Operations within a 180-degree arc can be cycled automatically. For 360-degree operation, levers are manipulated by each quadrant. Decutching the fluid drive motors converts machine to conventional mill.

Circle 572 on Readers' Service Card



Leland-Gifford tape-controlled drilling machine

Leland-Gifford Tape-Controlled Machine Designed for Production or General-Purpose Drilling

A tape-controlled drilling machine developed by the Leland-Gifford Co., Worcester, Mass., features quick adaptability to single-part, short-run, or continuous production drilling. Single-part operation can be controlled from the keyboard of the G-E Mark II numerical positioning control, or the coordinates can be dialed on the console mounted on the drilling machine. For repetitive work, standard eight-channel punched tape is used with a fast tape reader. Program can include automatic reversal for tapping and instant stops for tool and speed changes as indicated by flash tool-change lights.

The compound motion table is traversed hydraulically on ball-bearing mounted and guided round ways, with high-speed

positioning by self-contained, closed-loop, hydraulic circuits and reversible G-E Thy-Mo-Trol controlled motor-driven pumps. Positioning accuracy is plus or minus 0.001 inch, nonaccumulative, with repeatability of plus or minus 0.005 inch. The drilling unit incorporates a highly accurate, sensitive, precision ball-bearing spindle; zero float, quick-change chuck; six-station turret depth stop; and 5-inch traverse hand feed. A choice of spindle speeds in eight steps from 150 to 1800 or 150 to 3600 rpm is available. Drilling capacity is equivalent to 7/8-inch diameter in cast iron. The table has precision locating blocks, T-slots, and keyways which extend the work capacity beyond the table traverse.

Circle 573 on Readers' Service Card

SPRING DESIGN DATA—1

Types of Springs

Over the long history of mechanical design, dozens of different spring types — and millions of spring variations — have evolved. In Hunter Data, springs are classified into five types representing the bulk of modern usage in the precision, cold-formed

category. Other interesting and commonly used types are covered under a "Miscellaneous" heading. The following classification is based on the manner in which a spring stores energy and exerts its force.

COMPRESSION SPRINGS

Helical coil compression springs store energy by being compressed along the axis of winding. When permitted to release this energy, they expand in length and exert a pushing force. The ends of compression springs are usually flat.



Normal



Conical



Hourglass



Barrel



Volute



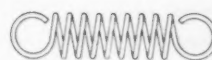
Special Ends

EXTENSION SPRINGS

Helical coil extension springs store energy by being forcibly stretched along the axis of winding. When permitted to release this energy, they contract in length and exert a pull. The spring ends must be fitted with hooks or other means of attachment to the members being drawn toward each other.



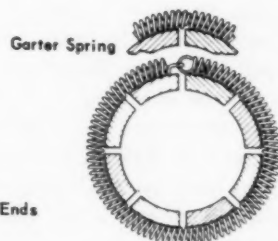
Close-Wound
(with initial tension)



Open-Wound



Special Ends



Garter Spring

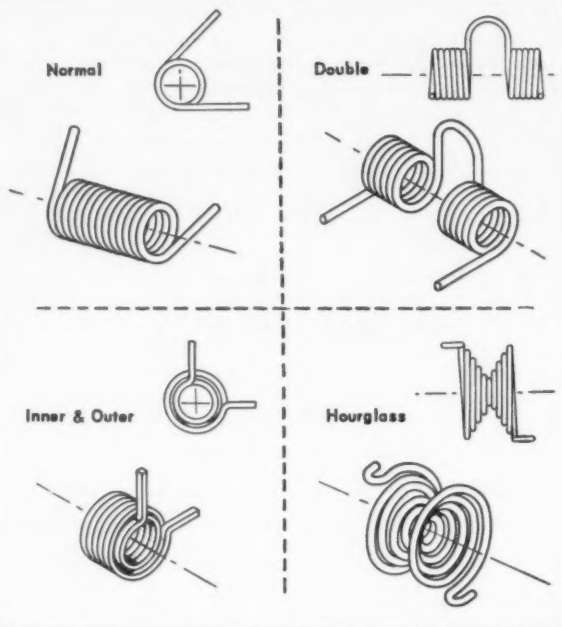
Courtesy of Spring Division, Hunter Spring Co., Lansdale, Pa.

SPRING DESIGN DATA—2

Types of Springs

TORSION SPRINGS

Helical torsion springs store energy by being twisted around the axis of winding. When permitted to release this energy they tend to unwind and exert a torque through arms or other connections at the ends.



SPIRAL SPRINGS

Spiral springs are similar to helical torsion springs, except that succeeding coils lie in the same plane and have gradually increasing radii. They exert torques about the axis of winding.

NEG'ATOR SPRINGS

A Neg'ator is a prestressed strip of flat spring stock which coils tightly about a bushing (or successive layers of itself). At any given time, only that incremental length is "active" which is in the process of being straightened from its natural radius of curvature to some larger radius of curvature. Energy is stored in a neg'ator by this straightening process, and released as the neg'ator is permitted to resume (or approach) its natural curvature on the bushing (or upon itself). Depending upon how it is connected, it may pull (like an extension spring) or exert torque (like a torsion or spiral spring). It is unique in that its contracting force can be made to vary in any manner as it is unwound or permitted to wind up — depending upon (a) the prestressing of the stock along its length and (b) the radius of curvature of the solid member around which it is permitted to tighten.

MISCELLANEOUS SPRINGS

In this category are (1) flat springs (cantilever, beam and leaf), (2) bent forms, (3) snap rings, (4) Belleville washers, and (5) torsion bars. Except for the last named group they store energy and exert their forces through bending moment.

Many springs commonly designated as special types may be considered as variations of the above five basic types. For example, conical springs, volute springs, hourglass springs and barrel springs are all varieties of compression springs. Further, the power spring (the mainspring of a watch) may be considered as a special variety of the spiral spring (the hair-spring of a watch).

Courtesy of Spring Division, Hunter Spring Co., Lansdale, Pa.

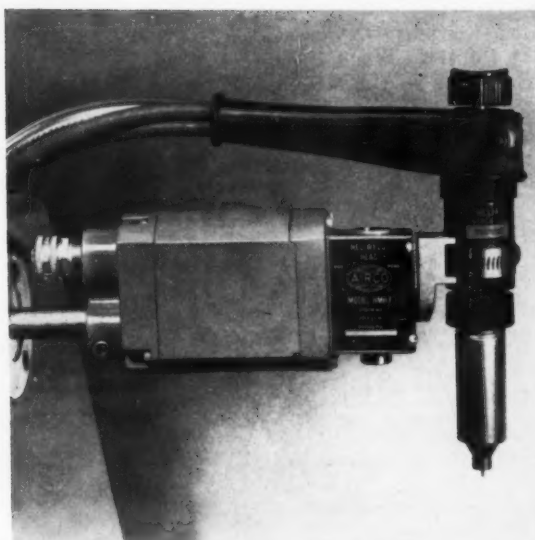


Fig. 1. (Left) Heliweld automatic welding unit. Fig. 2. (Right) Aircotron Model J electronic tracer

Airco Exhibits New Equipment at Welding Show

The Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City, demonstrated five new products at the recent American Welding Society Show in New York. Visitors to the exhibit saw for the first time Airco's Heliweld (gas tungsten arc) automatic head, Fig. 1. This unit features compactness with simple and economical operation. Also demonstrated were: the

Aircotron Model "J" electronic tracer, Fig. 2, which employs simple inked line templates on a Linagraph cutting machine; an Aircomatic MIGet gun package; Airco's hard-facing and brazing process—Aircospray; and Aircosil Fluxcor 45 silver-brazing wire. Air Reduction's Special Products Department also introduced a stake-seamer and welding-positioner unit, Fig. 3, in a live demonstra-

tion of practical applications.

A complete line of Airco's industrial gases, electrodes, and arc-welding machines; oxyacetylene welding and cutting torches; manual, semiautomatic, and automatic Aircomatic and Heliweld equipment; and arc- and gas-welding supplies and accessories were also on display.

Circle 574 on Readers' Service Card

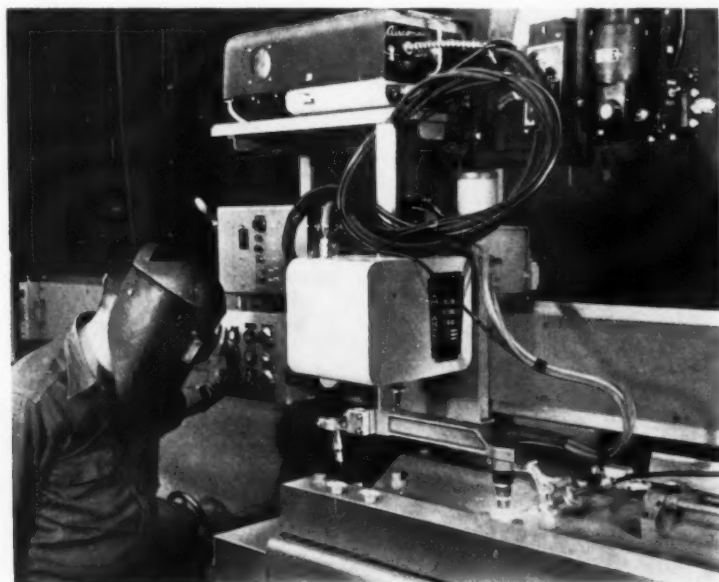
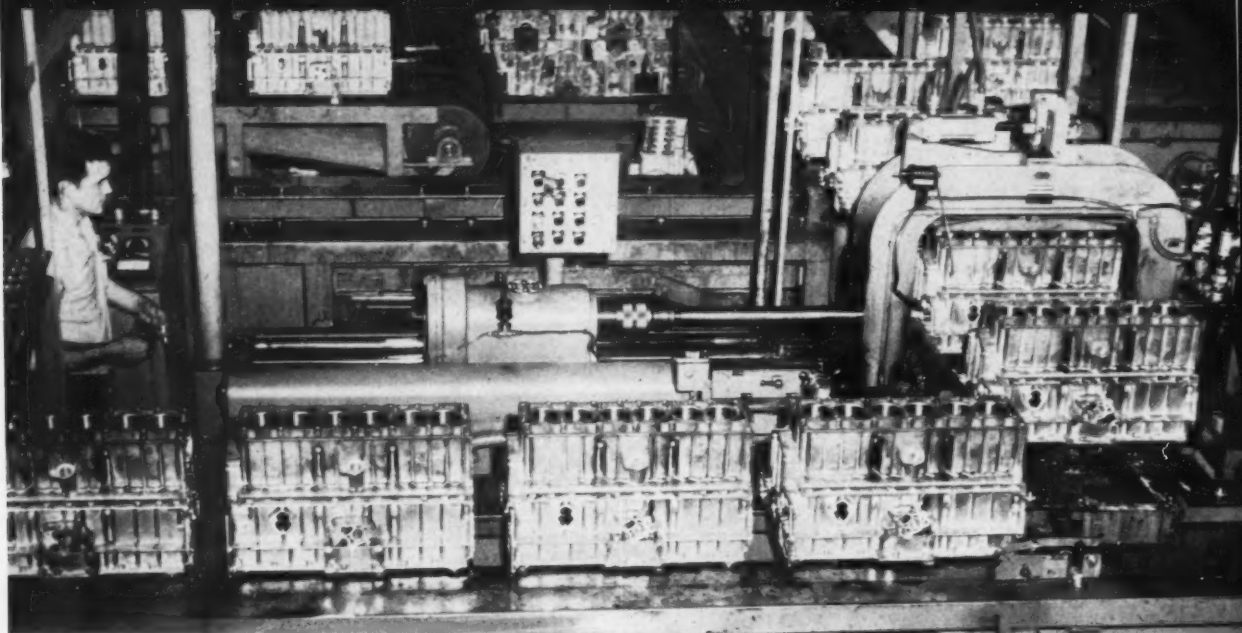
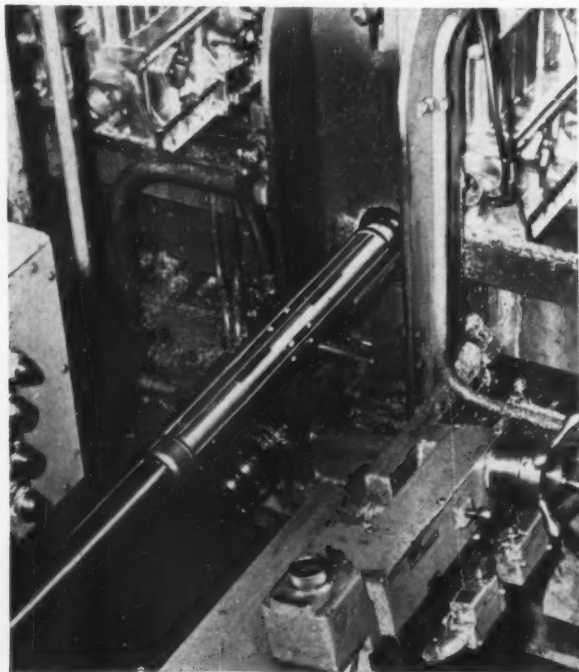


Fig. 3. Stake seamer and positioner introduced by Air Reduction Sales Co.

Microhoning main bearing bores



Moving from left to right along the conveyor line, the blocks are shifted laterally by the transfer mechanism at the end of the conveyor section, and then are brought to the Microhoning operation. The two 5HX40 Hydrohoners (the second machine, not shown, is located to the left, behind the operator in the photo) operate side by side. Each machine has a maximum 40" hydraulic spindle stroke and is equipped with automatic sizing controls, automatic stonefeed and stonewear compensating mechanisms, including stonewear indicator and controls.



BORES ARE

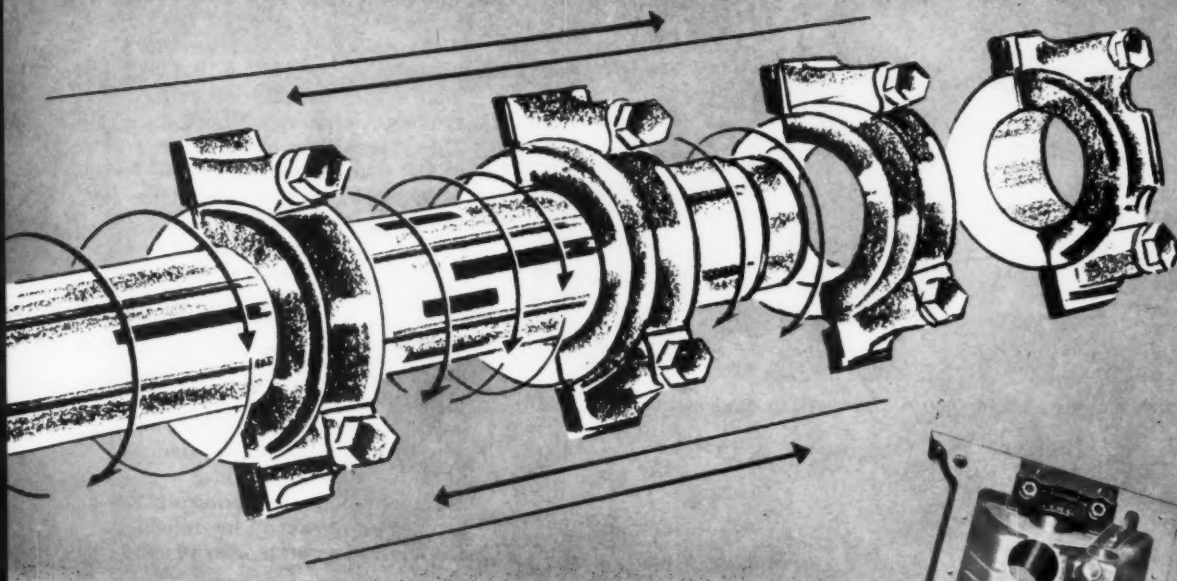
half cast-iron

*Microhoning produces
distortion-free bores and
same specified finish
in both metals*

◀ This is a good view of the Microhoning tool as it is entering the fixture and block. There is a single bank of abrasives in the middle of the tool and five banks of plastic guides (two banks forward and two aft of the abrasives—the fifth is mounted radially between the abrasives). Thus the tool is fully supported at all times and perfect alignment of all four holes is assured. Cycle is automatically ended when hole size is attained by means of an integral sizing device consisting of mandrel and air gage.



at **AMERICAN MOTORS**

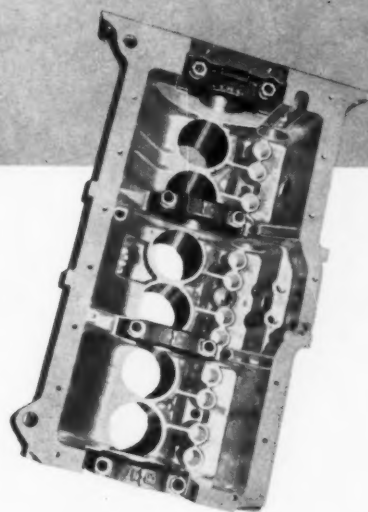


... half aluminum

The distinctive characteristics of stock removal, dimensional control and surface finish by Microhoning® are in dramatic evidence in the new American Motors transfer line in Kenosha. For here, in one cycle, Microhoning removes .0025" of stock from four dual-metal bores with same finish in both metals while maintaining distortion-free hole size and alignment.

The 1961 Rambler Classic cylinder block is die cast aluminum with cast iron bearing caps. Thus half the diameter of the four main bearing bores is aluminum and the other half is cast iron. The difference in machining characteristics and thermal coefficient of expansion for the two metals would normally present some tough processing problems. But the low velocity abrading technique of Microhoning provides the ideal answer.

Surface finish is uniform around the entire diameter and completely free of amorphous metal, grit and chips. Size is held within .0003", roundness within .0001", and alignment within .0002" throughout a length of 24 $\frac{3}{8}$ ". The cutting cycle takes only 27 seconds!



In virtually all metalworking industries, Microhoning is gaining recognition for its unique characteristics. No longer looked upon as a "finishing" operation alone, Microhoning is capable of maintaining greater control of size geometry and surface finish even during a roughing cut than any other machining method. Investigate its opportunities for you . . . our national sales engineering staff is well versed in *all* machining methods and can quickly point out the applications where Microhoning can give profits a helping hand in your operations. Why not drop us a line today. Incidentally, if you would like more information about the application described above, send for a copy of "Cross-Hatch" Vol. 13, No. 2.

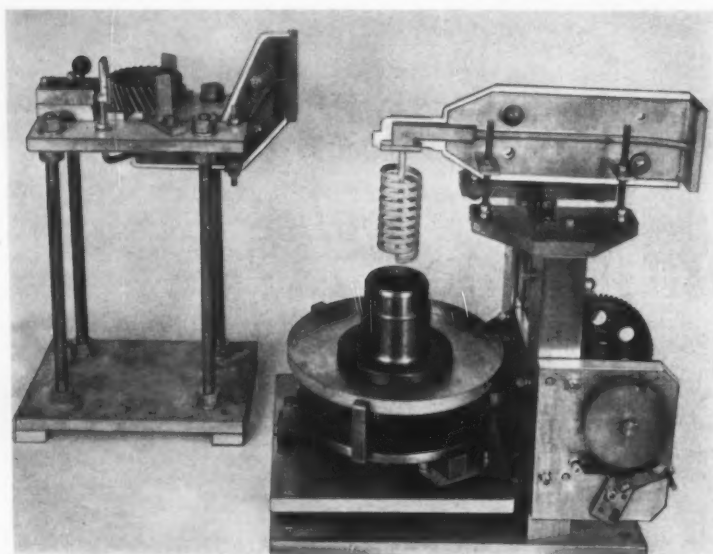
MICROMATIC HONE CORP.

8100 SCHOOLCRAFT AVENUE • DETROIT 38, MICHIGAN





Federal electronic comparator for checking master rings and discs



(Left) Coil in Ther-Monic unit shrink-fits gear on shaft in four seconds
(Right) Internal coil shrink-fits crankshaft damper in nine seconds

Ther-Monic Heating Units Equipped for Shrink-Fitting Jobs

Safe, easy-to-use, inexpensive Ther-Monic units equipped to perform shrink-fitting operations in seconds have been announced by the Induction Heating Corporation, Brooklyn, N. Y. Two new fixtures for these units designed for use by the auto industry handle two difficult shrink-fitting jobs. One is employed for the shrink fitting of gear shafts; the other, for the shrink fitting of crankshaft

dampers. Both are presently in use in plants of one of the major automobile manufacturers.

Unit "A" was fabricated for the heat shrinking of crank gears. The gear has an outer diameter of 2.50 inches, is 1.0 inch high, and has an internal bore of 1.750 inches. The inside diameter of this gear is heated with an internal three-turn work-coil. The coil and fixture are mounted together in a single unit

Electronic Comparator for Checking Master Rings and Discs

A comparatively low-priced electronic comparator (Model 136B-2) that checks master rings and discs to an accuracy within 0.000002 inch is announced by Federal Products Corporation, Providence, R. I. This comparator can measure inside diameters from 0.040 to 4.760 inches, and outside diameters from 0 to 3.5 inches. These measurements are made with a constant gaging pressure, since the contacts are mounted on a free-floating unit which eliminates all friction. Two scales are immediately available by switching: 11,200 \times magnification (0.000010-inch graduations) and 2200 \times magnification (0.000050-inch graduations) to suit requirements.

The amplifier is transistorized and battery-powered for reliable and instant operation with no voltage fluctuation. The mercury-cell battery pack provides 1200 to 1300 hours of service. When not required full time for checking masters in the gage laboratory, the completely portable amplifier can be used with an electronic gage head for other measuring applications in the shop or tool-room.

Circle 575 on Readers' Service Card

that, in turn, is readily mounted to the generator by four bolts.

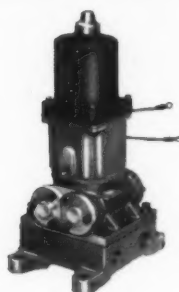
The gear is placed on the fixture, which has three guide posts to establish exact positioning and prevent any damage to the coil. The gear is then heated for four seconds, manually removed, and slipped onto the crankshaft. Since only the internal bore is heated for the four-second period, the outer rim of the gear remains cool and can be handled with bare hands.

Unit "B" was devised for the shrink fitting of the crankshaft damper. This part is 3.120 inches long, has an outer diameter of 2.600 inches, and an internal bore of 1.750 inches. The damper also has a flange housing with an outside diameter of 6 inches, and is used, in this case, as the locating



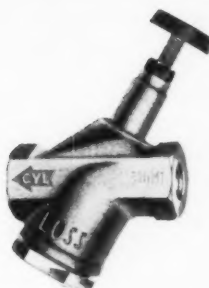
The stock shelves at **Ross** include more different air valves than any other stock shelves in the valve world

Do you know these air controls by **Ross**?



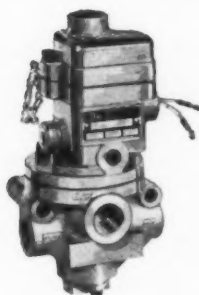
50 Million Cycles in Tests

Ross Goldmodel. A lightning fast, base mounted valve with its solenoid immersed in oil to run cool for long, long life. Full JIC. 3-way, 4-way and 4-way 5 port models. $\frac{1}{4}$ " through $1\frac{1}{4}$ ".



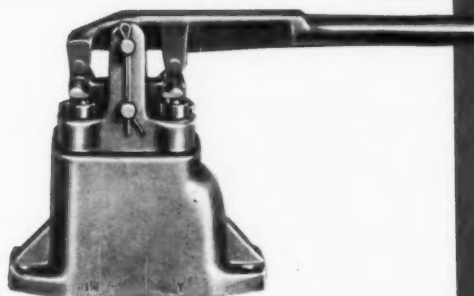
Control Cylinder Speed

Speed Control Valve. The adjustment screw directs air through an orifice that's engineered to give fine shadings of control at either high or low flow rates. $\frac{1}{4}$ " through $1\frac{1}{4}$ ".



Does a Big Valve's Work

"Headline Series". Highest capacity valve-size for valve-size of any valve we've seen. Use a smaller, economical inline valve to do a bigger, more expensive valve's work. Fast. S-way, 3-way, 4-way. $\frac{1}{4}$ " through $1\frac{1}{2}$ ".

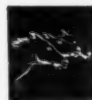


Especially for Tough Duty

Ross #100 series. Rough, tough jobs call for this valve which can pass most dirt and foreign matter with no trouble. Few moving parts and short poppet travel makes it especially wear resistant.

FOR OTHER ROSS VALVES SEE SWEET'S PRODUCT DESIGN FILE

The most complete line of air controls in the world
Ross OPERATING VALVE COMPANY
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point for fixturing. The coil is of the internal type with ten turns and an outside diameter of 1.50 inches. As in unit A, the fixture and coil are mounted together. The damper is placed on the fixture. A lift handle (not shown in the illustration) is turned and the part is elevated into the coil. Proper positioning is attained with a spring-loaded pawl on the cam.

A heat of 450 degrees F. is reached in nine seconds. The part is then removed from the fixture and slipped onto the crankshaft. Since this is a two-position setup, one side can be loaded while the other side is going through the heating cycle. The heating is performed by a Ther-Monic Model 750 having a 7 1/2-kw output with a 450-kc generator. This unit incorporates a built-in timer, output control, and low-voltage work-coils which can be touched without danger. An additional, optional accessory is an enclosed distilled-water-to-air heat exchanger. Through the use of high-frequency heating, both of these shrink-fitting jobs can be done with complete accuracy and in a fraction of the time required by other methods.

Circle 576 on Readers' Service Card

Miniature Air-Clutch and Brake Unit for Transmitting Power to Low-Tonnage Bench Presses

A miniature pneumatic clutch and brake package designed for high-efficiency power transmission for bench presses in the low-tonnage capacity ranges has been introduced by Fawick Airflex Division, Fawick Corporation, Cleveland, Ohio. Known as FSPA (Fawick Standardized Press Application), the new package incorporates a 6-inch diameter drum type air clutch and a 4-inch diameter self-energizing brake. The unit is designed for high-speed cyclic machines requiring extremely accurate starts and stops. The clutch portion of the package may be used in pulley-mounted applications.

This miniature unit incorporates the same design and performance characteristics as the larger Fawick FSPA series, widely used as original equipment and for press modernization.

The air-actuated clutch has a 360-degree friction surface, responds instantly to push-button control, and automatically adjusts itself for wear. The spring-engaged, air-released brake automatically engages in case of elec-

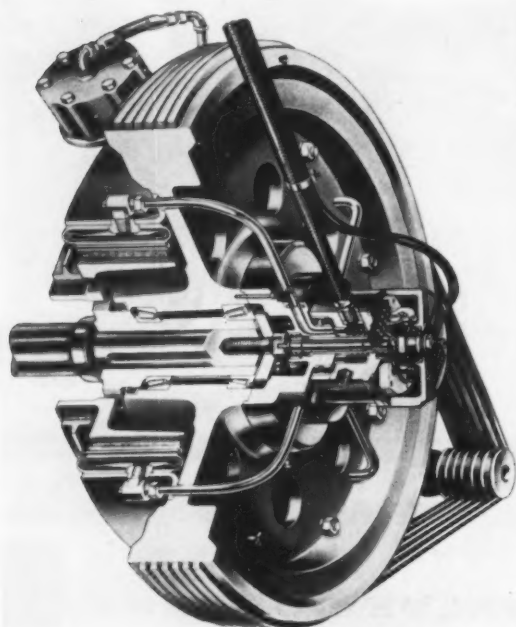
trical or compressed-air failure, providing fail-safe protection. The package eliminates backlash and protects tools and dies. Simplified design is said to provide low-maintenance operation. With the introduction of this miniature unit, the Fawick FSPA line is increased to twenty-six standard packages with air-clutch diameters from 6 to 36 inches.

Circle 577 on Readers' Service Card

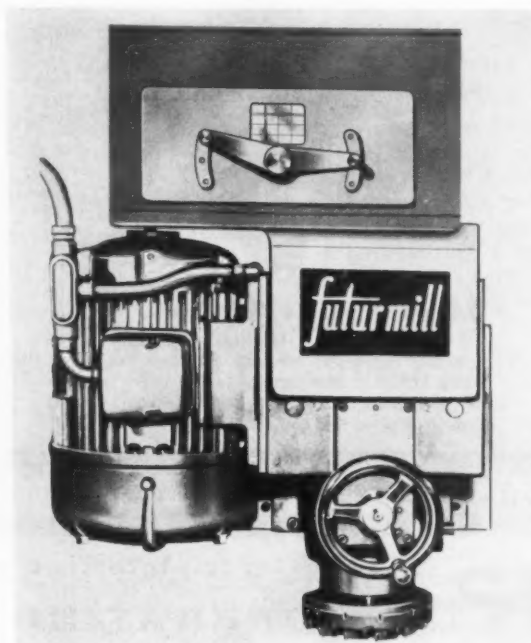
Spindle Unit for Conversion of Planers and Planer-Mills

A Series 5225 milling spindle designed as a conversion unit for planers and planer-mills has been announced by Futurmill, Inc., Pontiac, Mich. This 30-hp milling unit has a spindle-speed range of 50 to 1150 rpm. Speed changes are made by a convenient shifting lever. Constant horsepower is maintained throughout the entire speed range. The heavy-duty alloy-steel 6-inch quill (8 inches optional) has micrometer adjustment. Total weight of the unit is less than 2000 pounds.

Circle 578 on Readers' Service Card



Fawick miniature air-clutch and brake unit



Futurmill conversion unit for planers and planer-mills

OVERSEAS CAR BUILDER ADDS ANOTHER SNYDER TRANSFER MACHINE IN FURTHER MOVE TO CURTAIL COSTS

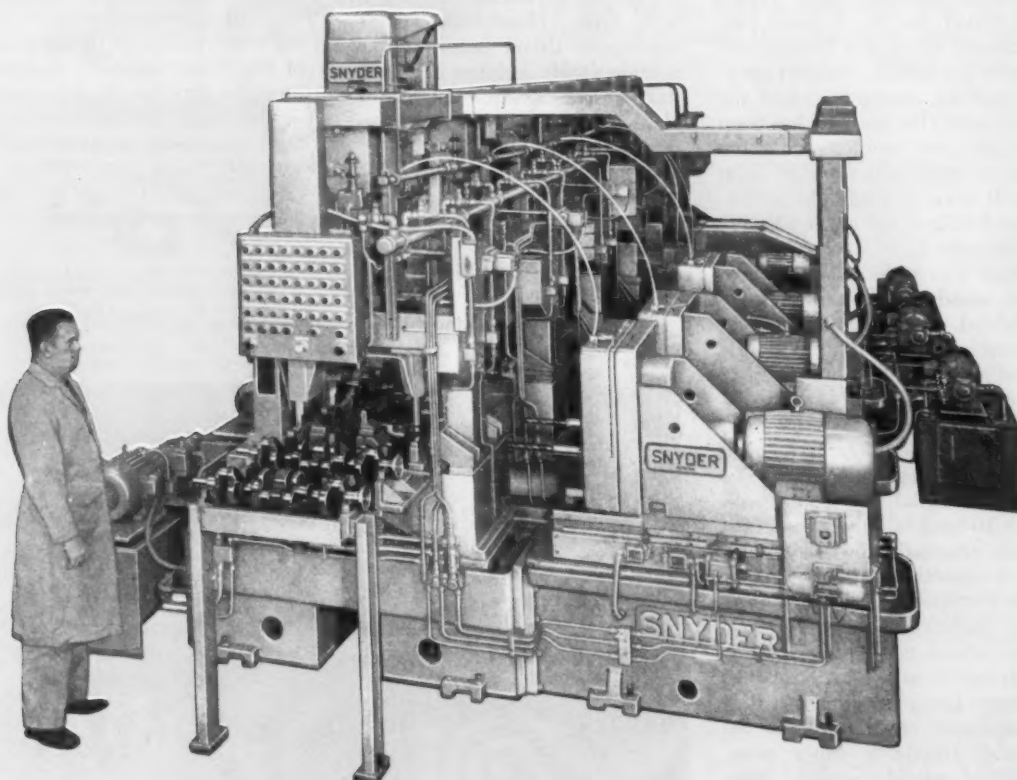
Intensified competition for world markets brought back this old friend of Snyder products seeking further relief from manufacturing cost and labor problems. The answer to this specific problem is a Snyder Special 20-station, building block transfer machine that drills, reams, taps, chamfers and precision-bores 78 automotive engine crankshafts per hour at 100% efficiency.

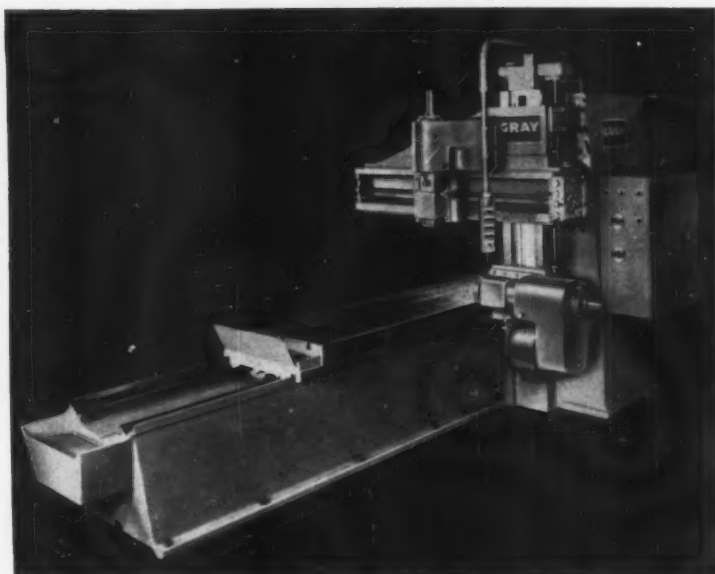
The overseas customer for whom the machine was built came to the U. S. and, specifically, to Snyder for this cost-cutting, labor-saving machine because of the availability of definite benefits. These include previous experience of Snyder's ability to successfully adapt high-production, cost-cutting techniques to limited production quotas, long experience exclusively in the special machine tool field, domestic and export, and appreciation of Snyder's fresh and creative approach to any pro-

duction problem. There were also the factors of Snyder's engineering and plant resources, assuring fast action and a delivery schedule probably not possible outside the U. S., and the availability of Snyder's standard units, pre-engineered and widely applicable. These same advantages are available to you. We'd like to hear from you.

SNYDER CORPORATION

3400 E. LAFAYETTE—DETROIT 7, MICHIGAN
Phone: LO 7-0123





Compact, budget-priced Gray Handymill open-side milling machine

Gray Milling Machine Equipped with Special Head

Following the introduction of its successful budget-priced Flying Scot planer, the G. A. Gray Co., Cincinnati, Ohio, has brought out an economy-model, compact open-side milling machine, called the Handymill. This machine has been developed to handle production work as well as everyday shop jobs. It will be available in 30-, 36-, and 42-inch basic sizes. Exclusive features include specially developed Gray milling heads to which standard attachments may be added. Any combination of rail and/or side heads is possible, providing the solution to almost any milling problem.

Milling heads are square-locked to the rail on nonmetallic bearing ways, assuring the high degree of rigidity essential to carbide milling. A 10-hp totally enclosed, fan-cooled, alternating-current motor with a smooth, positive-cog belt drives the spindle through a two-speed, balanced planetary gear system which is self-oiled. Eight speeds are available from 67 to 652 rpm. Large spindle bearings permit heavy cuts, using No. 50 National Standards taper nose, which is interchangeable with standard right-angle attachments. When both rail and side heads are used, the setup time can be

readily reduced to a minimum.

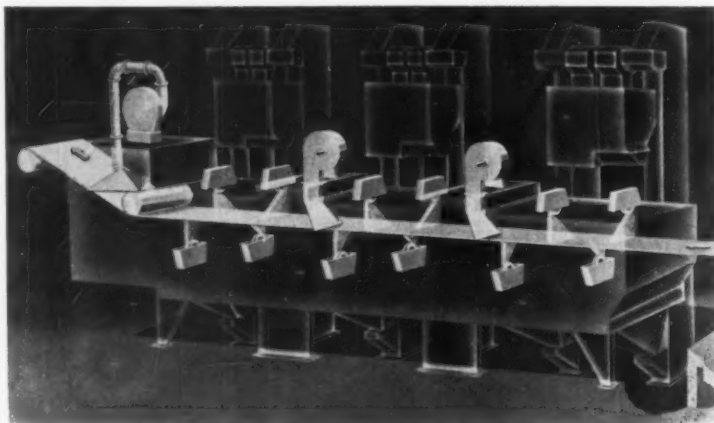
Like the Flying Scot planer, the new Gray Handymill features spacesaver drive, helicone transmission, wide column face, and sturdy knee construction. A complete new drive unit and gear ratio permit table and rail feeds of from 1 to 40 ipm. All controls are located in an easy-to-operate pendant station affording complete control of table movement. A quick spot control arrests table and head motion.

Circle 579 on Readers' Service Card

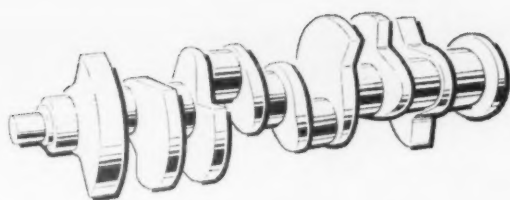
Pangborn Giant-Size Blast Descaler

A blast-descaling machine (said to be the largest and most powerful in the world) which is capable of processing an average of 120 tons per hour of continuous steel coils has been in operation since last July at the plant of the Empire-Reeves Steel Corporation, Mansfield, Ohio. Completely automatic, with a central push-button control panel, this 60-foot long machine prepares hot-rolled carbon and silicon strip for cold-rolling. The strip is used in automotive, electrical, and galvanizing applications. Designed and built by the Pangborn Corporation, Hagerstown, Md., the descaling installation will accommodate any strip between 24 and 50 inches in width.

Composed of three integral blast cabinets to simplify abrasive handling, the unit hurls 660 tons of abrasive per hour of blasting. Twelve Rotoblast wheels (totaling 900 hp) cover both sides of the strip simultaneously: six blasting downward, six upward. Each of the three cabinets contains a separate abrasive cleaning and recycling system. This includes two double-capacity elevators and two air-wash separators, feeding a single abrasive storage bin which supplies four Rotoblasts. Each pair of Rotoblasts (upper and lower) is adjustable for optimum coverage of various strip widths. Each may be removed for maintenance.



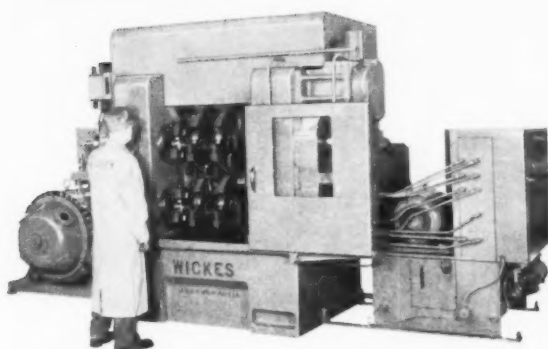
Phantom view of huge blast descaler built by Pangborn Corporation for Empire-Reeves Steel Corporation



WEIGHT WHERE IT COUNTS . . .



IN THE HEAVYWEIGHT CHAMP OF THE CRANKSHAFT WORLD—THE WICKES DOUBLE SPINDLE CRANKPIN LATHE



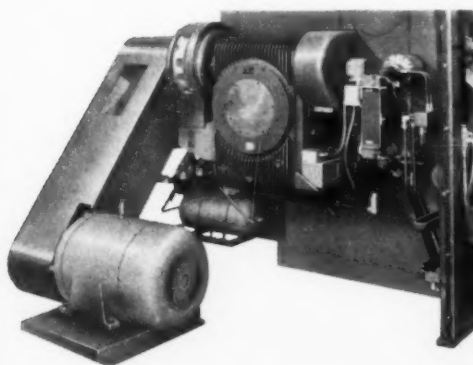
Planned, engineered weight gives the WICKES Double Spindle Crankpin Lathe the rigidity so essential for heavy intermittent cuts such as rough cheeking and turning crankpins. Weight where it counts makes the WICKES MX-4 ideal for accurate, smooth finish turning, spacing and filleting . . . provides precision accuracy in stroke, index, diameter and spacing of crankpins. A real production champ, the WICKES Automatic Double Spindle Crankpin Lathe is designed and built for machining all crankpins on two crankshafts *simultaneously* on all multiple throw automotive and similar tractor type crankshafts. With the MX-4, WICKES provides the ultimate in crankshaft production efficiency . . . and is ready to prove it . . . in steel.

The WICKES Automatic Double Spindle Crankpin Lathe, pictured here, boasts a main drive arrangement employing a worm gear, recognized for its quieter, smoother drive. Backlash is kept to a minimum, for greater accuracy, through this efficient worm gear drive and the use of compensating gears. Completely automatic, the WICKES MX-4 operates through electric push-button panels, including hydraulically operated chucks and steady rests, and is equipped with JIC approved hydraulic and electrical equipment.

world's only specialist in
CRANKSHAFT TURNING



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Whatever your production problem—whatever type of crankshaft you produce—rely on WICKESmanship for the most effective solution. Call on your WICKESman, or send us your blueprints and let the engineering ingenuity responsible for building and developing the world's *first* crankshaft lathe solve your production problems.

division of the

WICKES corporation



nance without stopping the machine or requiring a man to enter the cabinet. These and other features provide a completely fail-safe operation and allow a continuous flow of strip through the unit.

S-170 Rotoblast steel shot is used exclusively. Replenishment of the abrasive supply in each cabinet is accomplished automatically by a bin level-sensing system.

Circle 580 on Readers' Service Card

High-Speed Multiple-Hole Driller

The Coleman Machine Co., Inc., Berkeley Heights, N. J., has announced a Panto-Duplicator designed for high-speed multiple-hole drilling of metal, ceramic, epoxy, and other materials. Production drilling of printed circuit boards and other similar multiple-hole drilling operations can be accomplished rapidly and accurately.

The Panto-Duplicator operates in conjunction with a template and pantograph. Guided by the template, the work-piece is automatically controlled by a protective limit switch on the stylus. Thus, as soon as the stylus is fully seated in a hole on the template, a corresponding hole is drilled in the board. Simply by moving the stylus of the pantograph from hole to hole on the template, the work-

piece is drilled to exactly duplicate the hole layout in the template. A built-in vacuum exhaust system keeps the work-piece free of chips, shavings, and dust particles. The double bushing action, top and bottom of work-piece, assures clean holes that are free of burrs. Up to 4000 holes per hour can be drilled with precision and accuracy.

Circle 581 on Readers' Service Card

Havir Auto-Press

Increased press and die life are outstanding features claimed for a heavy-duty, 150-ton Auto-Press announced by the Havir Mfg. Co., St. Paul, Minn. This high-speed automatic press has an exclusive cylindrical type ram designed for

precision alignment of die and ram to give maximum ram rigidity. Adjustment for wear is provided for by tapered wedges in back of the ram bearings. Prior to installation in the press, the ram and bearings are carefully hand-lapped to assure an accurate assembly.

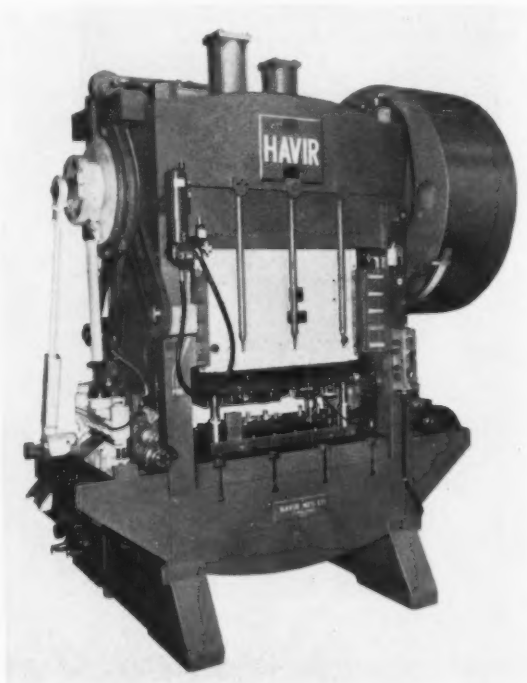
Extremely fine parallelism between the face of the ram, bed, and bolster plate are said to add to die life. The dies are protected by an automatic shutoff which stops the press automatically in the event of jamming or misfeeding, thus preventing costly breakage.

Standard operational speed is from 70 to 210 strokes per minute, using an 18-inch wide feed. Slower speeds can be had on order. The Auto-Feed is specially designed for this press. The air-clamped feeds prevent stock distortion and allow infinite controlling variations of roller pressure. Single or double feeds are available as optional equipment. Built-in shock mounts reduce vibration and crank-bearing wear.

The press is equipped with a



Coleman Panto-Duplicator for multiple-hole drilling



Press with automatic feed announced by Havir Mfg. Co.



Bendix SYSTEM-ENGINEERED Numerical Controls log 450,000 hours—with less than 5% downtime

The impressive number of hours logged by machines operated by Bendix® numerical control systems is just one index of leadership in the new era of metalworking. Even more significant is the downtime record. Reports from 30 users show that downtime ranged from 1% to 10%, with an average of slightly less than 5%. Persuasive figures on the practicability of Bendix numerical control systems.

Bendix training and service contribute markedly to maximum machine utilization. Immediately prior to delivery of the machine tool, Bendix trains user personnel who will supervise, operate, and maintain the equipment. When the machine tool is installed, Bendix field men aid in the initial set-up. To assure quality service, Bendix maintains a competent field organiza-

tion in branch offices throughout the country.

Bendix works closely with machine tool builders. And our numerical controls are *system engineered* to specific applications. Case histories prove that Bendix controlled systems cut production costs, reduce lead time, increase machine tool efficiency, and make parts of consistently high accuracy.

When you consider numerical controls—feasibility, installation, operation—call on Bendix. Investigate our complete line of control systems, both contouring and positioning. Let us explain our proved design techniques, including modular construction, transistorized plug-in circuitry, linear and rotary feedback devices, and high performance servo devices. Find out how Bendix can help you make new profits in metalworking. Write today.

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Industrial Controls Section

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variable-speed, 20-hp motor. Crankshaft diameter at the main bearings is 6 3/4 inches, with a diameter of 8 1/2 inches at the crankpin. Bed width front-to-back is 32 inches, and the bed opening is 30 by 18 inches or 46 by 18 inches. Knockout bars and scrap cutter are optional equipment.

Circle 502 on Readers' Service Card

"Flame-Clear" Rising Blocks for Supporting Work on Flame-Cutting Tables

The Brown & Sharpe Mfg. Co., Providence, R. I., has produced, in their own foundry, a new aid that practically eliminates costly maintenance of cross supports on flame-cutting tables. Called "Flame-Clear" rising blocks, these cast-iron, beehive-shaped blocks fit onto cross supports of any flame-cutting table for holding steel plate clear of the table and preventing the flame from cutting and damaging the table bed.

Because cast-iron does not cut readily, these blocks have greater flame resistance and longer life. They can be quickly arranged on the cutting table supports according to the pattern of the cut. These blocks give a firm, uniform working surface. They serve to prevent distortion, hold heavy plate or thin sections, prevent



Flame-cutting table equipped with B&S Flame-Clear work-supporting blocks shown in upper right-hand corner

"fall-away" of the finished piece, and reduce blow-back.

Savings on maintenance of flame-cutting table beds have run up to 400 per cent in the B&S plant as a result of using these

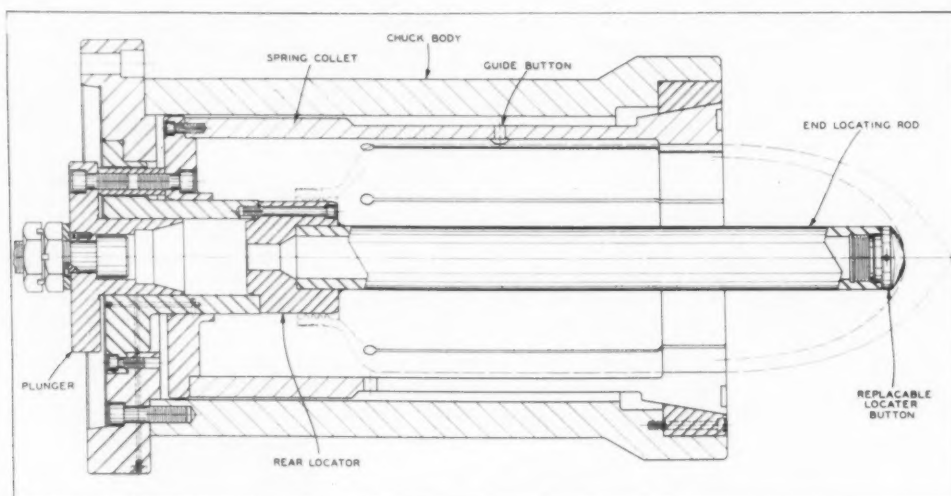
newly developed Flame-Clear blocks. The blocks come in two standard slot sizes—5/16 and 3/8 inch. Specials can be made for any application.

Circle 503 on Readers' Service Card

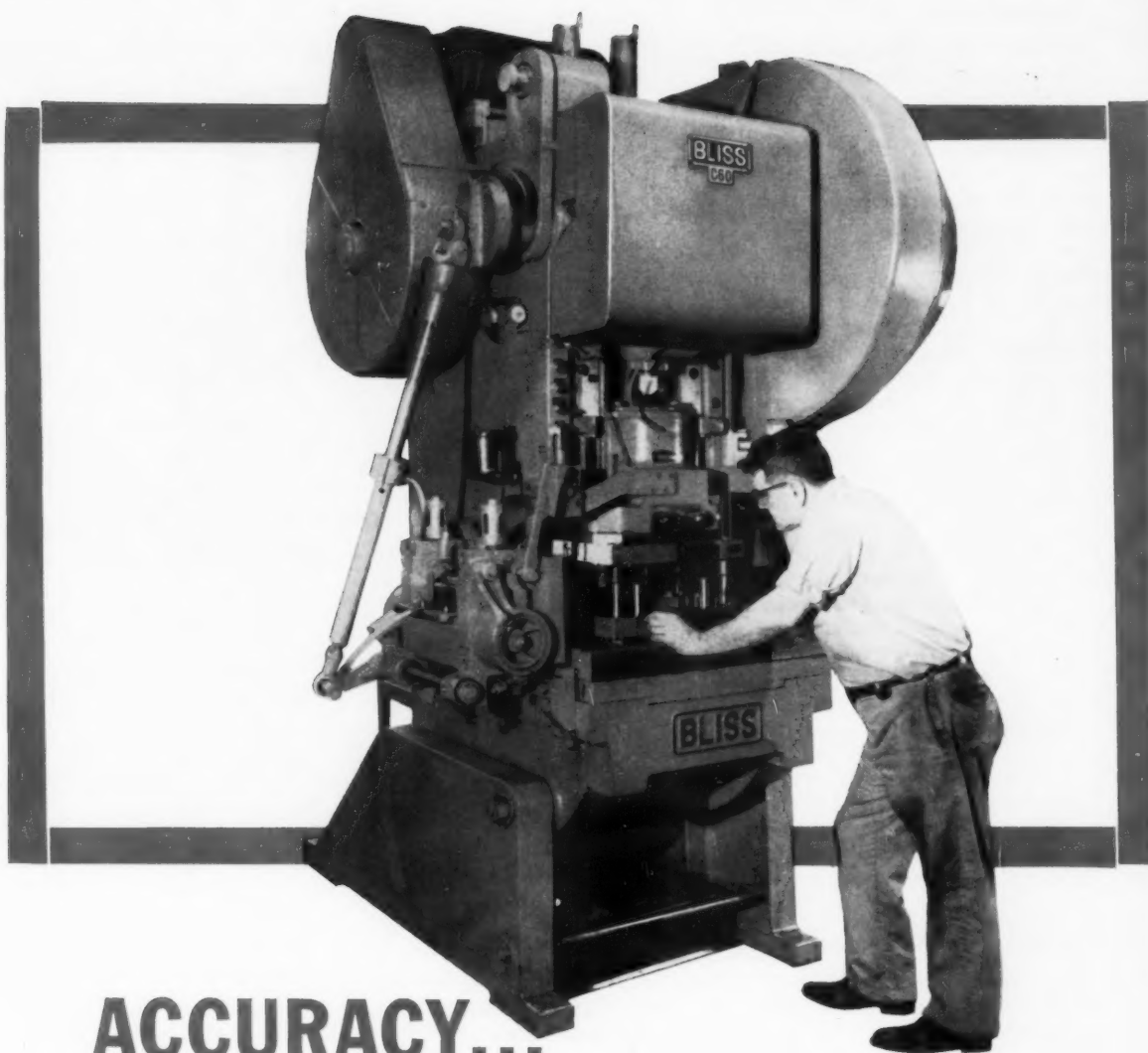
Collet Chuck for Bullpup Missile

Machining the Bullpup missile nose presented a complicated work-holding and locating problem. For maximum rigidity the missile (which measures approxi-

mately 31 inches long by 11 inches in diameter) must be gripped and supported as closely as possible to the surface being machined. To do this the Cushman Chuck Co.,



Cushman chuck designed to hold and accurately locate Bullpup missile for machining operations



ACCURACY...

that pays off in longer die life, longer press runs before regrinds, with new Bliss Big "C's" and new Bliss "swing-out" portable feeds

The extremely rigid design of Bliss Big "C" inclinables keeps frame deflection to a minimum, even when running at maximum tonnages. What does this mean in terms of actual performance? . . . At Oak Manufacturing Company, Crystal Lake, Ill., eighteen new Big "C" inclinables, equipped with special new Bliss "swing-out" roll feeds, have cut rejection rates sharply. In the case of one very difficult stamping, the rate has improved from 10% rejections down to 1%!

The new Bliss feed is far more accurate than the ones previously used. Moreover, it is designed to swing out away from the press during hand feeding, and can be readily transferred from press to press, regardless of the tonnage (Oak's new Big "C" presses range from 22-ton to 60-ton capacities).

The quality of Bliss Big "C" presses is spelled out both in their strength and, above all, in the precision of their construction, including nearly perfect parallelism between slide and bed, the close tolerances of all working parts, and in the high quality of material in the castings and forgings. Want more facts? Write us now for a complimentary copy of our detailed, full-color catalog.

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E. W. BLISS COMPANY • Press Division • Hastings, Mich.

PRESSES • ROLLING MILLS • ROLLS • CONTAINER MACHINERY • CONTRACT MFG. • PUBLIC SAFETY

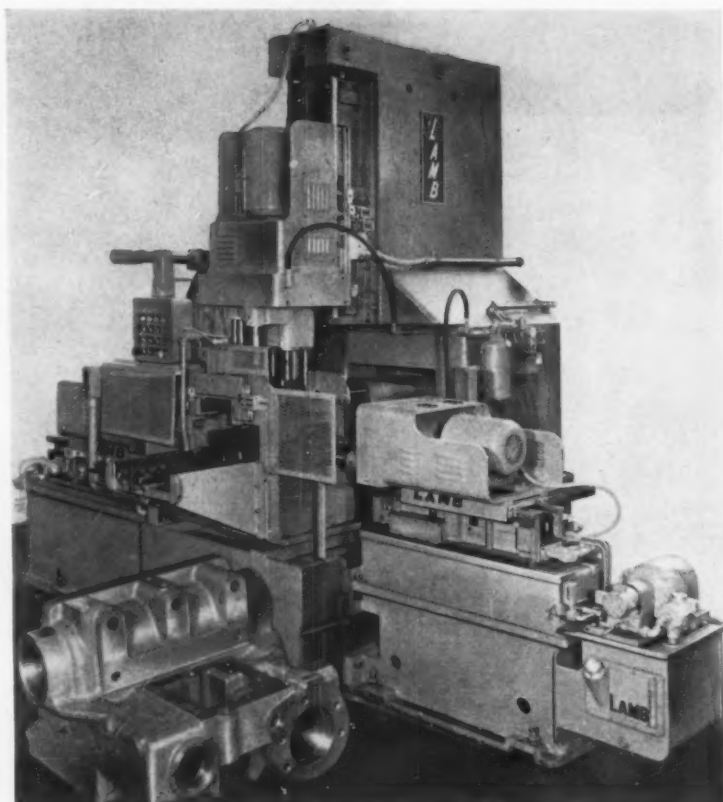
BLISS
SINCE 1857

Hartford, Conn., designed a special air-operated chuck to locate and hold the nose on a previously machined surface.

As can be seen in the accompanying cross-section view, the chuck incorporates a spring type collet operated by the plunger head. Work positioning is accomplished by means of guide buttons, a rear locator which is part of the chuck body, and the internal end-locating rod for locating the nose end of the missile. These features permit fast work positioning, chucking, and unchucking.

To load the chuck the operator inserts the end-locating rod inside the missile. Guide buttons inside the collet direct the missile onto the rear locator so that it is properly positioned for centering by the chuck. When air pressure is applied to the cylinder, the plunger is drawn back, pulling the collet down against the chuck body. After machining is completed, release of air causes the plunger to move forward and the spring collet releases the work. This chuck can be readily retooled for other sizes by changing the collet and locators.

Circle 584 on Readers' Service Card



Four-way drilling machine designed and built by F. Jos. Lamb Co.

Lamb Four-Way Machine for Processing Tractor Part

One vertical and three horizontal way units of a machine have been designed and built by F. Jos. Lamb Co., Detroit, Mich., to drill, chamfer, spot-face and form valve seats in tractor power-lift housings. The vertical column of this machine is of the tunnel type. It straddles one of the horizontal slide units, eliminating the need for an additional machine to spot-face and chamfer one hole in the part.

The unusual column is designed to provide easy access to the horizontal slide controls for service and adjustments. Tool changing is accomplished through the side of the column after retracting the slide to the full return position. Parts are delivered to the machine on a roller conveyor and manually moved into the fixture on fixed rails.

Hydraulically actuated wedge type overhead clamps hold the part securely during machining.

The unit is part of a segmented line designed for low-volume production and quick conversion. The production rate is approximately thirty-two parts per hour at 100 per cent efficiency. Operations are performed dry. The center base has a chute for convenient chip removal. All electric and hydraulic components conform to JIC standards.

Circle 585 on Readers' Service Card

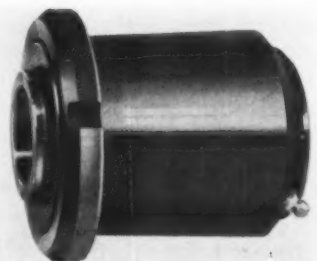


Fig. 1. Antifriction arbor bearing introduced by Briney Mfg. Co.

Briney Antifriction Arbor Bearing

An antifriction arbor bearing of new design, Fig. 1, is available in standard sizes to fit the support housing of a machine without re-boring, as shown in Fig. 2. This bearing has just been introduced by the Briney Mfg. Co., Pontiac, Mich. It has a large number of balls, distributed evenly over the bearing race to provide full-length support, minimize friction, give

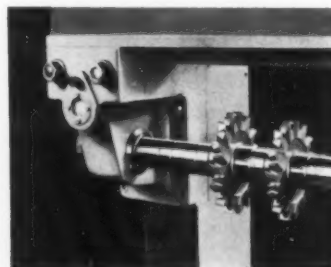


Fig. 2. Milling arbor supported by Briney antifriction bearing

Value Analysis Fact Sheet

ANACONDA FREE-CUTTING BRASS ROD

Not the plain old work horse many think, it can be produced with a variety of valuable properties—in addition to high machinability—to do many special jobs better, and at lower cost.

For the great majority of high-speed screw machine jobs, free-cutting brass rod is a standard shelf item.

But in an increasing number of jobs, the free-cutting property alone is not enough. Deep drilling to close tolerances, roll-threading, knurling, staking, slotting, etc., call for uniformity in a variety of other property combinations.

Fortunately free-cutting brass is a unique "on the fence" alloy (see Metallurgical Comment at the right) that can be adapted to answer these new demands—help screw machine operators meet increasingly rigid requirements and utilize cost-saving practices.

Specialized applications. Over the past several years, Anaconda American Brass has introduced several refinements into the usual mill practice for free-cutting brass and has developed different rods for specialized applications. In most instances, these rods will still meet ASTM and Government specifications.

Chip breaking. For the user who demands a rod with uniform ability to break up into small chips, an alloy is supplied which regularly contains substantial quantities of beta. This, because it is brittle at room temperature, adds to the chip-breaking ability of the lead already there. This rod is, therefore, particularly good for high-speed forming and drilling applications. On the other hand, it is the least ductile and can therefore be formed and headed to the least extent.

Cold forming. The usual and more numerous special applications require uniform ability to be cold-worked—as in roll-threading, knurling, heading, and other deforming.

Properties of these special rods are refined by heat treatment or special drawing operations so that the rod can be consistently cold-worked. Normally, there is little sacrifice in machinability, but there is some loss in the ability of the rod to break into small chips.

Deep drilling. In small rod particularly, there has been an increasing demand for material that can be drilled to close tolerances. Special drawing and heat treating practices were developed to produce a rod which performs uniformly, even in such exacting applications as ball point pen tips.

High Strength. And for those applications calling for uniformly higher strength than the usual material, there is a rod produced by special drawing practices.

Technical assistance. If you have a special problem—whether it involves a variation of free-cutting brass or another free-cutting or engineering copper alloy—call in your Anaconda American Brass representative. He'll make available to you the experience and services of metallurgical and mill specialists. Or write: Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

FOR MORE INFORMATION about Anaconda Rods for Screw Machine Products—including physical properties, mechanical properties, composition and machinability—write for Publication B-14. Address: Anaconda American Brass Company, Waterbury 20, Connecticut.

Metallurgical Comment

Free-Cutting Brass can provide relatively wide variations in temper and ductility within the range of composition defined in ASTM and Government specifications (60 to 63% Cu, 2.5 to 3.7% Pb, remainder Zn).

In the commonly available rod temper, referred to in ASTM specifications as "half hard" and more commonly in the trade as "hard," tensile strength may range from 50,000 to 70,000 psi, depending on the rod size and the manufacturer.* And there can be a comparable variation in cold-working properties.

Here's why. The range of 60 to 63% copper was selected for free-cutting brass because it is the lowest which can be used to produce an alloy that can be hot-worked readily and also cold-worked. This means a brass that can be hot-extruded down to small sizes—and that later can be cold-worked to a modest degree.

In more technical terms, free-cutting brass is at the transition point between the alpha phase (the ductile form of the alloy) and the beta phase (the form that's hard and brittle at room temperature but readily worked when hot). Thus, relatively minor changes in composition and fabrication practices can make substantial shifts in the proportion of alpha and beta grains—hence in strength and ductility. Various combinations of these properties can be maintained uniformly by careful control of mill practices.

Free-cutting property of the alloy is, of course, provided by lead dispersed through it—and is not materially affected by changes in other properties.

Standard Anaconda Free-Cutting Brass-271 has a composition of 61.50% Cu, 3.25% Pb, 35.25% Zn. This composition and the mill procedures used are designed to provide a rod which will fit the great majority of high-speed screw machine work.

*In special hard temper the tensile strength of small sizes will approach 90,000 psi.

ANACONDA®

FREE-CUTTING ROD

Anaconda American Brass Company

longer bearing life, and increase arbor rigidity. Simplification of design is said to permit a price reduction of 25 to 30 per cent on these bearings, as compared to previous models. The new design also eliminates stress and strain imposed on the bearing by lineal movement of the arbor due to thermal changes. It is also claimed that the bearings run cooler and last longer.

Since these bearings are seated within the support housing, work,

and fixture interference is non-existent. Their free-running support allows higher feeds and speeds so that machine and cutter capacities can be fully realized. Inexpensive reducing bushings are available for each size bearing so that a standard range of arbor diameters may be accommodated. Installation is said to be easily accomplished by simply fitting the bearing in place and securing it with a lock-nut.

Circle 586 on Readers' Service Card

Wet-Blast Cabinet with Work-Handling Device

A manually operated wet-blast cabinet, Model A-45, with an optional work-handling device known as the Rollo-Table has been introduced by the Pressure Blast Mfg. Co., Inc., Manchester, Conn. Measuring 50 inches wide by 40 inches deep by 75 inches high, those areas of the wet-blast cabinet in contact with abrasive slurry are fabricated of stainless steel. Skirting is fabricated of galvanized metal. Two double-thickness side work-loading doors provide 30- by 30-inch access to the interior of the cabinet, which has an internal working area measuring 50 inches in width by 36 inches

in depth by 40 inches in height.

Equipment includes: a heavy-duty, overrated blower for mist evacuation; large viewing window with fluorescent lighting and window-wash device; elliptical armports with armrests providing gauntlets for maximum operator comfort and freedom; knee-operated controls; and special two-day, caster-mounted settling basin to aid in changing abrasive. The hopper, where abrasive and water are contained, is slab-sided and pyramidally shaped and features air agitation for the suspending of the abrasive in the water.

The Rollo-Table is mounted to

the left of the cabinet and is bolt-attached. Measuring 54 inches wide by 40 inches deep by 34 inches high to the top of the table, the unit incorporates inverted angle-iron tracks which run into the cabinet and a plastisoled expanded metal rotary table fitted on a sealed bearing, mounted in turn on a carriage with machined wheels. The area beneath the rails on the outside of the cabinet features a rinse facility.

In operation, work to be finished, such as heavy dies or molds, is placed on the rotary table and manually pushed into the cabinet. During the blasting operation the operator may use one hand to rotate the table while the other hand is used to manipulate the blast gun. At the completion of blasting the table is rolled out of the cabinet, over the rinse area, and washed free of residual abrasive. It is then removed.

The Model A-45 unit includes the exclusive high-velocity blast system developed by Pressure Blast as well as a regular-velocity system operating on the aspiration principle. The version of the cabinet incorporating only the regular-velocity system has been designated Model AA-45.

Circle 587 on Readers' Service Card
(This section continued on page 176)



Fig. 1. Model A-45 wet-blast cabinet and Rollo-Table introduced by Pressure Blast Mfg. Co., Inc.

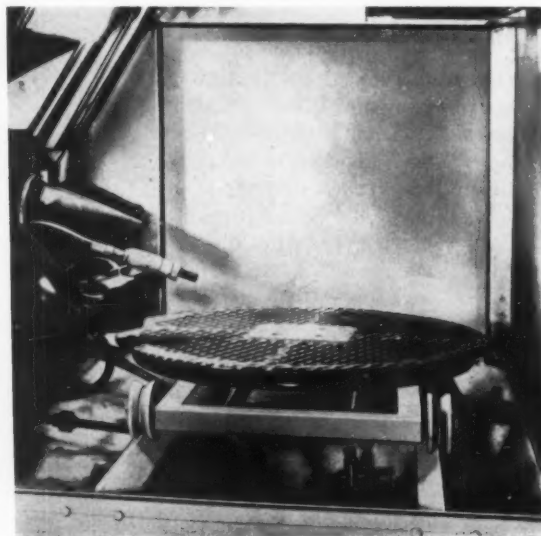


Fig. 2. Interior view of blast cabinet (Fig. 1) showing Rollo-Table work-handling unit

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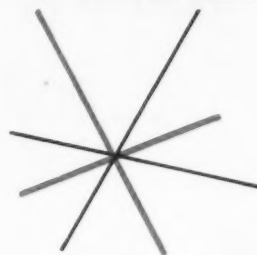
Company Name _____

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NEW

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Load Control

Machinery Electrification, Inc., Northboro, Mass. Booklet on the application of "Load Controls"—devices which analyze the usage of electrical power by a machine or process. Advantages are increase of productivity, protection of machines, etc.

Circle Item 501 on Inquiry Card



Temperature Recording

Brush Instruments, division of Cleveland Corporation, Cleveland, Ohio. Booklet (Form TR) describing how a Brush universal carrier amplifier and a platinum resistance sensor are applied to record temperatures from minus 320 to plus 2000 degrees F.

Circle Item 502 on Inquiry Card



Cutoff Machine

Rockwell Mfg. Co., Delta Power Tool Division, Pittsburgh, Pa. Bulletin covering the Delta 12-inch cutoff machine, which is available in four models for dry-abrasive cutting, wet-abrasive cutting, nonferrous cutting, and woodcutting.

Circle Item 503 on Inquiry Card



Electroplating Filters

Udylite Corporation, Detroit, Mich. Brochure listing specifications for a line of side-opening filters built for easy maintenance and maximum removal of contamination from all kinds of plating solutions and the filtration of other liquids.

Circle Item 504 on Inquiry Card



Retaining Rings

Industrial Retaining Ring Co., Irvington, N. J. Catalogue No. 1331 giving specifications and new prices for Series 1000 (open type, radial assembly), Series 3000 (internal, axial assembly), and Series 3100 (external, axial assembly) retaining rings.

Circle Item 505 on Inquiry Card



Wide-Belt Finishing

Carborundum Company, Niagara Falls, N. Y. Folder discussing case-study results in which the use of wide belts and wide-belt machines for both woodworking and metalworking cut costs and expedited production while maintaining quality.

Circle Item 506 on Inquiry Card



Tool-Lease Program

Kearney & Trecker Corporation, Milwaukee, Wis. Bulletin giving details on a program (with a choice of three plans) that allows customers to lease new Kearney & Trecker machine tools for specified periods of time for use in their own plants.

Circle Item 507 on Inquiry Card



Ultrasonic Cleaning Equipment

Branson Instruments, Inc., Stamford, Conn. Brochure on Sonogen ultrasonic cleaning equipment. Details on cavitation, generators, transducers, transducerized tanks, and immersible transducers are included, along with charts and specifications.

Circle Item 508 on Inquiry Card



Optical Comparator

Nikon Inc., New York City. Catalogue (Supplement 59A) providing data on the firm's optical comparators with coated Nikkor lenses. The high-resolution image is said to permit observation of fine specimen detail to an extreme degree of accuracy.

Circle Item 509 on Inquiry Card



Equipment Leasing

United States Leasing Corporation, San Francisco, Calif. Brochure presenting data on the leasing of new and used equipment. Included are conservation of capital and credit, tax-timing benefits, balance-sheet effect, cash-flow improvement, etc.

Circle Item 510 on Inquiry Card

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Hard-Facing Electrodes and Wires

Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City. Catalogue (Form ADC 955) on hard-facing electrodes and wires. Wear protection on industrial and construction equipment by Airco hard-facing alloys is discussed.

Circle Item 511 on Inquiry Card



Carbon-Graphite Materials

National Carbon Co., division of Union Carbide Corporation, New York City. Bulletin S-5425 giving details on carbon-graphite materials. Grade recommendations are presented for seals and sliding surfaces for a wide range of liquids and gases.

Circle Item 517 on Inquiry Card



Milling Cutters

Futurmill, Inc., Pontiac, Mich. Catalogue presenting the firm's line of indexable-blade milling cutters. Featured are milling feeds and speeds, troubleshooting procedure and check-off list, and factors that determine the degrees of finish.

Circle Item 512 on Inquiry Card



Servo Valve

Moog Servocontrols, Inc., East Aurora, N. Y. Catalogue 710 covering the Series 71 industrial servo valve. In this closed-center, four-way sliding spool valve the output flow to a constant load is proportional to electrical input current.

Circle Item 518 on Inquiry Card



Di-Profiler Accessories

Hyprez Division, Engis Equipment Co., Chicago, Ill. Booklet on techniques and accessories for the Di-Profiler reciprocating hand machine. Featured are straight and ruffle diamond files, carbide files, and needle and Swiss pattern steel files.

Circle Item 513 on Inquiry Card



V-Belt Drive

Fort Worth Steel & Machinery Co., Fort Worth, Tex. Catalogue Section 50-C presenting instructions and engineering data for selection of both stock and nonstock multiple V-belt drives. Standardized QD (quick-demountable) sheaves are included.

Circle Item 519 on Inquiry Card



Press-Brake Control

General Automation Corporation, Secaucus, N. J. Catalogue featuring a description of the company's Autobend BC 100 press-brake control, which is said to provide every feature from automatic whipless bending to straight power-press work.

Circle Item 514 on Inquiry Card



Ring Sprockets

Cogmatic Division, American-Marietta Co., Milwaukee, Wis. Bulletin No. 1606 on a line of ring sprockets, which are used as original equipment or replacement ring sprockets on conveyor mechanisms, construction equipment, welding equipment, etc.

Circle Item 520 on Inquiry Card



Hydraulic Seals and Packings

Disogrin Industries, Mount Vernon, N. Y. Catalogue covering the various types, sizes, operating features, and advantages of a complete line of solid-urethane hydraulic seals and packings. A description of Disogrin, a urethane elastomer, is given.

Circle Item 515 on Inquiry Card



Overhead Spindle

Cincinnati Milling Machine Co., Cincinnati, Ohio. Catalogue No. M-1963-2 giving data on a 3-hp independent overhead spindle. The self-contained unit, with eight spindle-speed changes, is for Cincinnati 203-10ML and 205-10MI milling machines.

Circle Item 521 on Inquiry Card



Magnetic "Sheet Floater"

Dings Magnetic Separator Co., Milwaukee, Wis. Bulletin 1208B-N giving details on the magnetic "Sheet Floater"—a development used to facilitate the handling of stacked steel sheets during production operations such as pressing, punching, etc.

Circle Item 516 on Inquiry Card

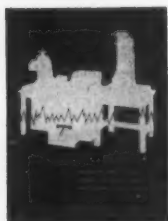


Linear Actuating Equipment

Cutler-Hammer, Inc., Airborne Instruments Laboratory Division, Deer Park, N. Y. Brochure providing application data on "Inchworm" linear actuating equipment. Motor Types 202 and 203, a heavy force armature, and modification kits are discussed.

Circle Item 522 on Inquiry Card

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Profile Measurer

Micrometrical Mfg. Co., Ann Arbor, Mich. Brochure on the company's Proficorder, which is used in both the laboratory and shop for measuring and recording roundness, flatness, roughness, waviness, scratches, flaws, and total surface profiles.

Circle Item 523 on Inquiry Card



Range Drives

U. S. Electrical Motors Inc., Los Angeles, Calif. Brochure No. F-2028 giving a description of the application of U. S. Varidyne all alternating-current controlled speed systems to range drives for paper, fabric, plastic, and metal strip.

Circle Item 529 on Inquiry Card



Hard-Surfacing Electrode

McKay Co., Pittsburgh, Pa. Data Sheet No. B giving information on Hardalloy 48, an iron-powder, low-hydrogen hard-surfacing electrode with high deposition rates. Surface of the weld bead is extremely smooth, minimizing frictional resistance.

Circle Item 524 on Inquiry Card



Work-Holding Devices

Sutton Tool Co., Sturgis, Mich. Bulletin No. 70 describing collet chucks, diaphragm chucks, mandrels, arbors, collets, boring-bars, adapters, spindles, and other work-holding devices of special design, both power and mechanically operated.

Circle Item 530 on Inquiry Card



Precision-Ground Steels

Vanadium-Alloys Steel Co., Latrobe, Pa. Folder citing the advantages of using precision-ground steel and explaining the features of three grades, including chemical composition and applications. Price lists and heat-treating data are provided.

Circle Item 525 on Inquiry Card



Stainless-Steel Components

Morton Machine Works, Millersburg, Pa. Catalogue No. 2 featuring Morton "Midgets"—stainless-steel standard components. Clamp straps, rest buttons, two-way jig legs, hex-head equalizing nuts, and fixture studs are some of the items covered.

Circle Item 531 on Inquiry Card



Turret Lathe

Warner & Swasey Co., Cleveland, Ohio. Brochure covering specifications and attachments for the company's No. 3 universal ram type turret lathe, designed to handle bar work up to 1 1/2-inch diameter or chucking work with swings up to 15 3/8 inches.

Circle Item 526 on Inquiry Card



Drilling Machines

Burgmaster Corporation, Gardena, Calif. Bulletin covering the Burgmaster tape-controlled turret drilling machine—Models 2BHT, 25AHT, 3BHT, and 3BHT-B, including six- and eight-spindle machines with capacities of 3/4, 1 1/4, and 1 1/2 inches.

Circle Item 532 on Inquiry Card



Exploded Views

Mischka Co., Inc., Cleveland, Ohio. Bulletin on the exploded view type of illustration used in commercial and military publications, to enhance sales presentations, to assist in training programs, and to facilitate plant assembly operations.

Circle Item 527 on Inquiry Card



Overload Pitman

Dayton Rogers Mfg. Co., Minneapolis, Minn. Bulletin on a hydraulic overload pitman which can be used on practically any power press. Applications include briquetting, coining, embossing, marking, pressing, riveting, sizing, stenciling, etc.

Circle Item 533 on Inquiry Card



Lap-Grinding Machine

Speedlap Corporation, Skokie, Ill. Bulletin S-161 featuring details on various models of the Speedlap machine for lap-grinding operations. Advantages are discussed, along with accessories, such as a lapping compound and abrasives.

Circle Item 528 on Inquiry Card



Take-Ups

Link-Belt Co., Chicago, Ill. Book 2741 presenting the company's complete line of take-ups—available in seven frame styles and equipped with sleeve, ball, or roller bearings—which include built-in ability to compensate for shaft misalignment.

Circle Item 534 on Inquiry Card

MOTOR DRIVE HOUSING

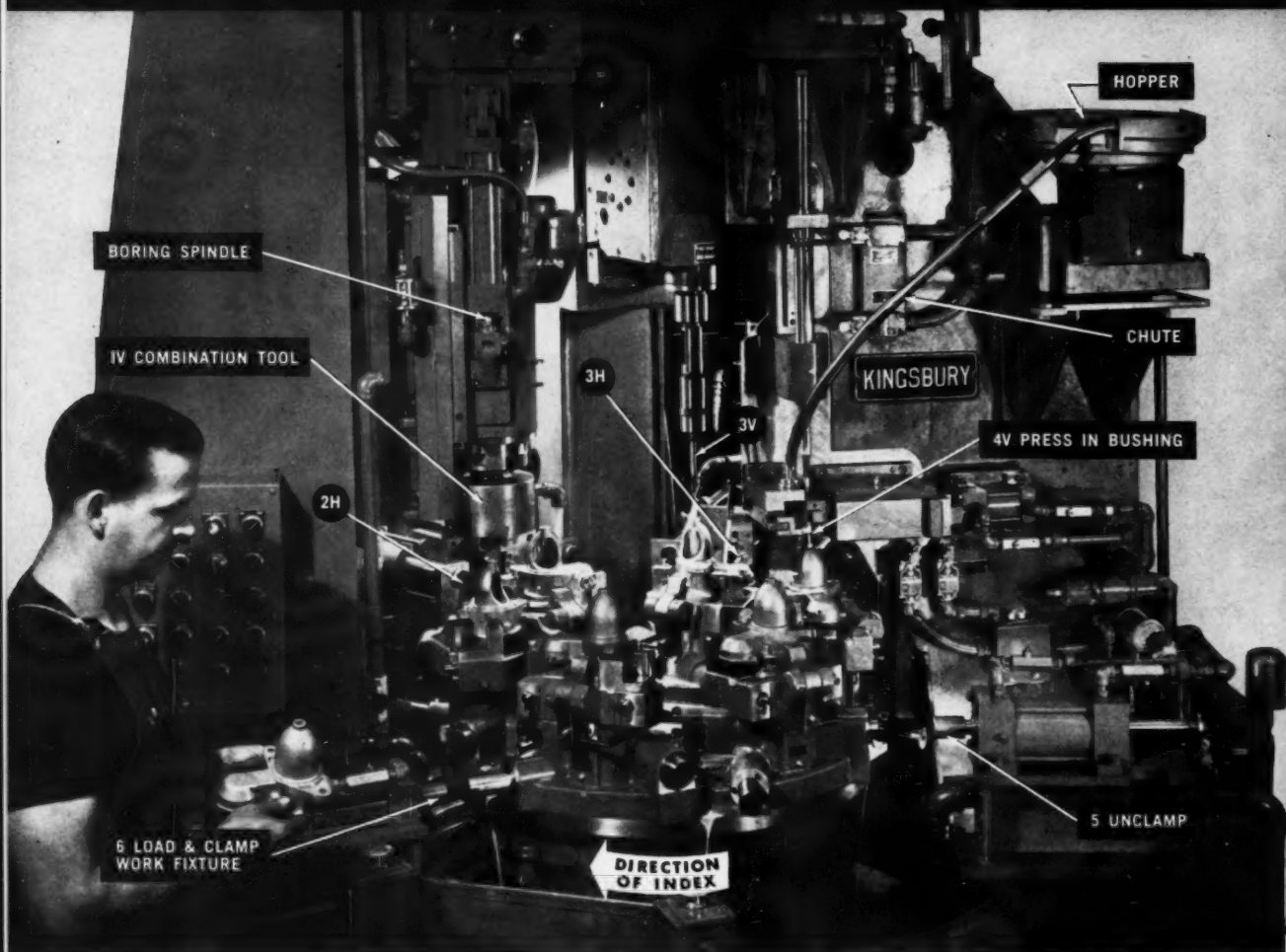
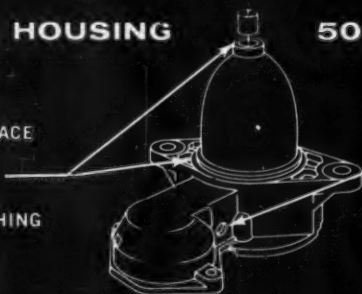
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Milling Machine

G. A. Gray Co., Cincinnati, Ohio. Bulletin No. 77 containing information on the Handymill open-side milling machine. Nonmetallic vee table ways, heli-cone transmission, bed and table, lubrication, space-saver drive, etc., are described.

Circle Item 535 on Inquiry Card



Wheel-forming Attachment

Parker-Hartford Corporation, Hartford, Conn. Brochure covering data on the firm's Optidress—an attachment to dress grinding wheels optically. A 10× microscope is used to assure a perfect blend between radii and angles in forming the wheel.

Circle Item 541 on Inquiry Card



Internal Grinder

Bryant Chucking Grinder Co., Springfield, Vt. Folder providing complete specifications and details on the company's double-end internal grinder, which is designed for grinding both a straight and a tapered bore at a single chucking.

Circle Item 536 on Inquiry Card



Screw-Machine Products

Merit Specialties Co., St. Louis, Mo. Brochure featuring the firm's screw-machine products and services, which will be of interest to buyers, engineers, designers, and production personnel who assemble machinery, appliances, or components.

Circle Item 542 on Inquiry Card



Coordinate Measuring Machine

Sheffield Corporation, Dayton, Ohio. Brochure giving details on the Ferranti FI-22 coordinate measuring machine for fast, precise measuring of the location of holes and surfaces of parts in two dimensions. Applications are described.

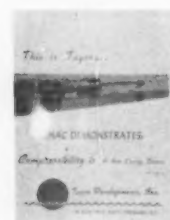
Circle Item 537 on Inquiry Card



Carbide-Tipped Saws

Atkins Saw Division, Borg-Warner Corporation, Greenville, Miss. Catalogue No. 60-CT listing carbide-tipped circular saws and band saws regularly supplied for cutting woods; laminates; and composition materials, plastics, and nonferrous metals.

Circle Item 543 on Inquiry Card



Linear Accelerator

Tayco Developments, Inc., North Tonawanda, N. Y. Brochure A on a linear accelerator for controlled acceleration, velocity, and deceleration under test conditions. Tayco facilities for development and engineering contract work are described.

Circle Item 538 on Inquiry Card



Air Gages

Standard Gage Co., Inc., Poughkeepsie, N. Y. Catalogue No. 61 on the company's air gages, designed as a tool to help in proper gage selection. Basic design data for the gage engineer and ordering information for purchasing personnel are given.

Circle Item 544 on Inquiry Card



Diaphragms

Diaphragm Industries, Inc., Beverly, Mass. Catalogue on elastomer-fabric diaphragms. Long-stroke, rolling, pre-convoluted, and molded convolution diaphragms for static or dynamic applications in aircraft and industrial use are discussed.

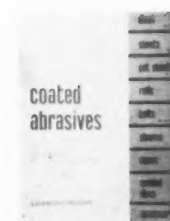
Circle Item 539 on Inquiry Card



Corrosion Resistance of Zirconium

Zirconium Association, Cleveland, Ohio. Booklet containing graphs for over 100 highly corrosive media in concentrations up to 100 per cent and temperatures up to 400 degrees F. Alphabetical listing of the media provides ready reference.

Circle Item 545 on Inquiry Card



Coated Abrasives

Carborundum Company, Niagara Falls, N. Y. Catalogue featuring information on coated abrasives for the automotive trades. Listed are discs, sheets, rolls, belts, sleeves, cones, molded discs, and accessories used in the repair of auto bodies.

Circle Item 540 on inquiry Card



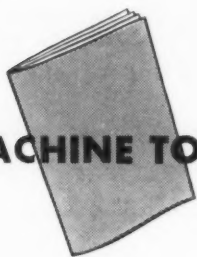
Ultrasonic Cleaning Systems

Acoustica Associates, Inc., Los Angeles, Calif. Bulletin giving data on a self-tuning, transistorized 20-kc line of ultrasonic cleaners. Advantages include lighter weight and compactness, automatic compensation for load and liquid levels, etc.

Circle Item 546 on Inquiry Card

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MACHINE TOOLS



Steelweld Catalog #2011 lists complete line of their **SHEARS** available in all sizes for cutting steel plate to thickness of 2". To obtain circle 22

Verson Catalog G-60 describes representative models of their entire line of Mechanical and Hydraulic **PRESSES**. To obtain circle 32

Wales Strippit catalog describes some of their units containing **PUNCHES**, Dies and Stripping Guides and Springs. To obtain circle 52

Gisholt **TURRET LATHES**—speed selector for 12 or 24 speeds, separate lever controls for cross and longitudinal traverse—for literature containing more information circle 55

Blanchard Machine's booklet "The Art of Blanchard **SURFACE GRINDING**"—ground finishes to 2-micromes—Flatness to 1—light band—To obtain circle 56

National Acme offers bulletin DV-1 "Fine circular **CHASER THREADING**." To obtain circle 63

Gleason's **GEAR CUTTER** "Revacycle" presents fastest way known for cutting precise straight level gears—for bulletin containing additional information circle 67

South Bend's catalog of their **LATHES**, **MILLING MACHINES** **DRILL PRESSES** and Pedestal **GRINDERS** includes specifications and sizes. To obtain circle . . 70

Hardinge Bros.—bulletin on their new high speed precision **LATHES**. To obtain circle 74

E. W. Bliss Company, offers full color catalog showing their complete line of **PRESSES**. To obtain circle 159

Induction Heating Company's new 56 page catalog of facts about their Electronic—Low Frequency Motor Generator **INDUCTION HEATING** equipment. To obtain circle 169

Goss & De Leeuw offers illustrated literature on their line of automatic **CHUCKING** machines. To obtain circle . . . 178

Burgmaster Corporation has literature available on their bench model **TURRET DRILLS**. To obtain circle 189

Sheldon Machine catalog features their line of **LATHES**, **MILLING MACHINES** and **SHAPERS**. To obtain circle . . 190

Avey bulletin describes their MA-8 Precision **DRILLING MACHINES** capacity to 3/8" 8-spindle speed. To obtain bulletin circle 192A

Armstrong Blum Mfg. has new catalog on Marvel Saws #8. Universal Metal Cutting **BAND SAWS**. To obtain circle 193

Benchmaster Mfg. has literature available on all of their **PRESS ROOM EQUIPMENT**. To obtain circle 194

George T. Schmidt catalog #18 shows their complete line of **MARKING** equipment. To obtain circle 208

Sundstrand Machine bulletin 629-1 features designs of their **MILLING MACHINES**. To obtain circle 832

Barnes Drill Company's Catalog 200 gives detailed story on their line of **HONING** machines. To obtain circle 835

Sundstrand Machine bulletin 629-1 describes solutions to high volume production arrived through use of their **TRANSFER MACHINES**. To obtain circle . 836

UNIT PARTS

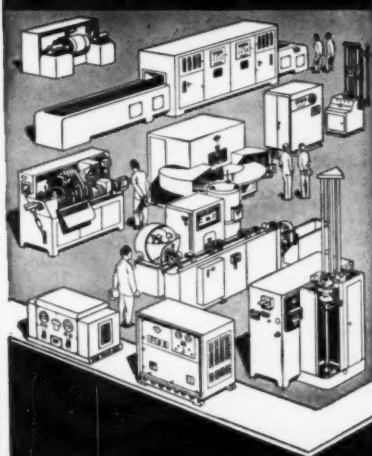


Ex-Cell-O Corp. offers catalog listing their **HYDROLIC POWER UNITS** for heavy duty boring and other operations. To obtain circle 23

Hoover's bulletin 106 describes their pillow block **BEARINGS**, automatically self aligning in any direction. To obtain bulletin circle 31

Continued on page 170

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Allen-Bradley offering information on their Push Button (catalog 800T) and limit switch (catalog 802T) motor **STARTERS**. To obtain circle 40

Baush Machine offering literature on their machining units for both drilling and tapping, featuring mechanical **LEADSCREW FEEDS**. To obtain circle 42

Laminated Shim Co.'s **SHIMS** custom made to your specifications. To obtain their catalog circle 72

C A Norgren Co. offers new catalog for designers and users of compressed air. To obtain this catalog on their **PNEUMATIC PRODUCTS** circle 163

Standard Electrical Tool Company has catalog available on their line of precision **SPINDLES**. To obtain circle . . . 186

Milling machine arbor support bushings replaced by Sonnet **ROLLER BEARINGS** on late model equipment. For catalog circle 192B

Ruthman Machinery offers catalog giving information on their original motor drive centrifugal machine tool **COOLANT PUMP**. To obtain circle 198

Eisler Engineering Co.'s **CAMS** of all types and sizes made to your specifications. To obtain their catalog—Circle 209C

GAGING AND TESTING EQUIPMENT

National Broach & Machine's catalog features their Red Ring **GEAR TESTER**—Can now be equipped with electronic amplifier to measure sound intensity. To obtain circle 38

Cadillac Gage Co. offers detailed literature on their Pla-Chek **GAGE** now being used in manufacture of guided missiles and electronic armament systems. To obtain circle 68

MATERIALS

For publication "B-14" containing additional information about Anaconda **RODS** for screw machine products circle 161

Inland Steel Company offers booklet "Properties of Ledloy **STEELS**. To obtain circle 173

Bethlehem Steel booklet "548" gives full data on their Air-4 free machinery medium—alloy **TOOL STEEL**. To obtain circle 179

CUTTING TOOLS

Continental Tool Works Div. Ex-Cell O offers catalog featuring their standard and special size **BROACHES**. To obtain circle 19

Leland Gifford offers detailed bulletin on their **GUN DRILL** equipment—To obtain circle 57

Circular Tool Company's Catalog "P" lists more than 1200 of their products, including their **SAWS, SLITTERS** and combination **CENTER DRILLS**. To obtain circle 185

Chicago Latrobe's Catalog #60 gives complete listing and prices of their line of **DRILLS**. To obtain circle 187

National Twist—**DRILLS**. Detachable heads allow resharpener without removing drill shank from machine—To obtain manual on "Target & Center Cut Gun Drills" Circle 204-205

Winter Bros. Co.—**TAPS**—To obtain their informative brochure on taps that thread: aluminum, brass, copper, ductile steel & die castings by a chipless forming process. Circle 204-205

Cratex Mfg. Co. **RUBBERIZED ABRASIVES** for micro deburring, smoothing, cleaning and polishing. To obtain complete industrial catalog circle . . . 209A

Fish-Schurman Corporation's—**DIAMOND WHEELS**—Specializing in non-standard sizes. To obtain their catalog circle 215B

MISCELLANEOUS

Oakites' new booklet features use of their **CLEANER** in passivating and cleaning missile propellant loading systems. To obtain circle 16

Armstrong Bros. **TOOL HOLDERS**—for literature to help you in your tool holder selection needs. Circle 36

Textile Machine Works—booklet "Facilities File Folder" describes their **SUB-CONTRACTING** facilities. To obtain circle 60

Wespo Div. Vlier Eng.—**CLAMPS**. To obtain 16 page catalog featuring variety of Wespo Clamps. Circle 66

Gulf Oil Corporation's bulletin on their **COOLANT**—"Gulfcut" shows many cost cutting benefits. To obtain circle 142-143

Malleable booklet "Data" unit #16 describes versatility of their Ferrite and Pearlitic **CASTINGS**. To obtain circle 180-181

Texaco—**CUTTING OIL** booklet. "Clear-tex in automatic screw machines" features cutting oil dilution. To obtain circle 182

Lubriplate Div. Fiske Bros. "Data Book" features their grease and fluid type **LUBRICANTS**. To obtain circle . . . 195

Danly Machine's new literature shows how their new "Precision Pilot Guide Posts" assure perfect alignment for fast **DIE SET** assembly. To obtain circle 200

Insta-Clamp Company's bulletin #57 features their line of **CLAMPS** without shims. To obtain circle 211D

feel free to use cards below ... to obtain free literature on products advertised or described in this issue

1. Circle page numbers of advertisements—if no page number appears on ad, refer to advertisers' index.
2. Circle item numbers of new equipment, catalog descriptions.
3. Mail . . . we'll do the rest.

For Advertisements—Circle Page Numbers

1	2	3	4	5	6	7	8	9	10	11	12
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For New Equipment, Catalogues—Circle Item Numbers

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COMPANY

CO. ADDRESS

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STATE



information center

Reverse side of this card gives instructions on how to use postcards below to obtain new catalogues, data on new equipment described, and products advertised in this issue.

This card expires October 1, 1961

FIRST CLASS
Permit No. 53
New York, N. Y.

BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

MACHINERY

93 WORTH STREET

NEW YORK 13, N.Y.

READERS' SERVICE DEPT.



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FIRST CLASS
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MACHINERY

93 WORTH STREET

NEW YORK 13, N.Y.

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PUSH IT

You don't have to baby it—Ledloy® steel actually performs at its highest efficiency when you really push it! ■ Take a tip from the many shops getting amazing results with this go-the-limit steel. Increased machinability, higher speeds and feeds, reduced tool wear with greater production per tool change—all these advantages are yours—if you push Ledloy steels. ■ Inland pioneered in the making of leaded steels—has the solid background that means dependable

recommendations for your kind of operation and your specific product. Be sure the leaded steels you use are Inland Ledloy steels—the result of more than 20 years of research, development and continuous production. Ledloy steels are available from your Cold Drawer or your local Steel Service Center. Send for “Properties of Ledloy Steels,” an informative booklet Inland will be glad to mail at your request.

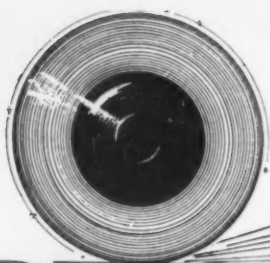
LEDLOY® STEELS CAN TAKE IT!

the world's most machinable steels

INLAND STEEL COMPANY

30 West Monroe Street • Chicago 3, Illinois





By E. S. Salichs

BETWEEN GRINDS

Eternal Editing

From the Libreria Bonilla in Mexico came a request for an article entitled "The Design of Automobile Springs," published in *MACHINERY* in January, 1910. Yes, 1910—fifty years, five decades, half a century. There seems to be no expiration date on our readers' requests.

Canny Crane

A radio-controlled bridge crane is now in use at the Chicago, Ill., plant of Joseph T. Ryerson & Son, Inc., steel and aluminum distributor, and is reportedly the first to be operated in any steel service center in the country. The remote control is accomplished by means of a battery-

operated transmitter worn by an operator on the floor. An antenna under the crane cab picks up the signals—keeping the rabbit's ears to the ground, as it were.

Be Brief or Breathless

Electronic Secretary Industries has designed a telephone answering set for business offices which takes up to two hours of continuous recording. Handles the long lunch hour.

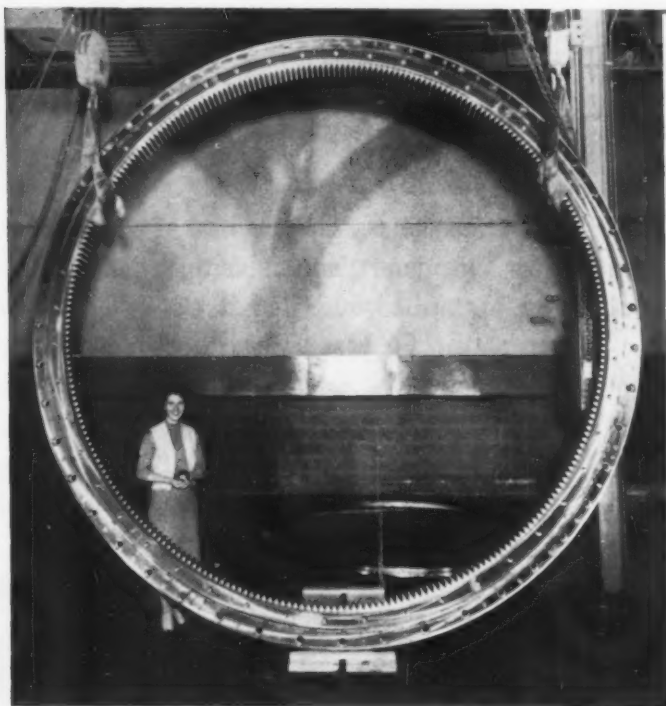
As Goes Gearing

Happy harbinger of the business trend is the volume increase of 37.1 per cent reported by the American Gear Manufacturers Association for the month of March. The AGMA

bookings index is computed to be 299.3 for March as against 218.3 for February (1947-1949 = 100).

Global Gossip

The proposed transpacific telephone system will be the next step toward telephone cables encircling the globe, according to *Industrial Research Newsletter*. The Pacific system will be over 8000 nautical miles long and will have a capacity for at least eighty simultaneous telephone conversations. That didn't sound like many; but then the thought occurred to us, How many times would we, or anyone we know, call Sydney, Auckland, Suva, Fanning Island, or Hawaii. Well, maybe to contact the nut-brown maiden.



WING-DING RING—Seven huge precision ball bearings have been made for use in America's latest air-defense radar system by the Kaydon Engineering Corporation, the system itself being the work of the Sperry Gyroscope Co. for the Air Force. Each bearing supports a radar antenna almost the width of a football field, built on a concrete tower 85 feet high. The girl seen in the picture is there to show the size of the bearing, not vice versa.

HOW DO YOU LIKE THE BOSS' SINGER
NUMERICAL CONTROL?

WONDER
WHAT THE
OLD LADY
DREAMED UP
THIS
TIME?



THESE NEW SINGER UNITS
ARE GREAT!

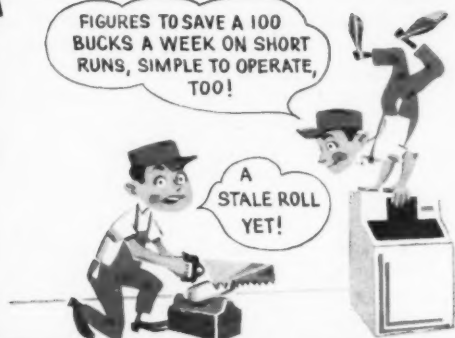
SALAMI!
ALWAYS
SALAMI!



THE NOON WHISTLE (one of a SINGER® series)

FIGURES TO SAVE A 100
BUCKS A WEEK ON SHORT
RUNS, SIMPLE TO OPERATE,
TOO!

A
STALE ROLL
YET!



YEP, THE BOSS SURE IS A
SMART OPERATOR.

A SMART
OPERATOR
I COULD
USE
AT HOME!



YOU, TOO, CAN SAVE WITH SINGER NUMERICAL CONTROL

These actual case histories show how 41½ hours of machine shop production by the usual method were reduced to 5½ hours with SINGER Numerical Control:

JOB	USUAL METHOD	SINGER NUMERICAL CONTROL	
		2 Hours	
(1) Drill Jig for Terminal Board, Jig Bore all Holes	8 Hours	First Piece —	25 Min.
(2) Jig Bore 38 Holes in each of Three Chassis	3 Hours/10 Min. x 3 Pieces	Second and Third Pieces —	16 Min.
(3) Nine Motor Housings	Total 9½ Hours	Total	41 Min.
a. Layout 6 holes and drill on faces of housings	1 Hour/10 Min. x 9 Pieces	First Piece —	23 Min.
	Total 10½ Hours	Next 8 (total) —	48 Min.
		Total	71 Min.
b. Layout 7 holes and drill on outside diameters of housings	1 Hour/30 Min. x 9 Pieces	First Piece —	26 Min.
	Total 13½ Hours	Next 8 (total) —	72 Min.
		Total	98 Min.
Grand Total:	41½ Hours	5½ Hours	

MOST IMPORTANT, you'll find that SINGER Numerical Control will pay for itself in a **very** short period of time. For full details, write to the address below:



DIEHL MANUFACTURING COMPANY

SUBSIDIARY OF THE SINGER MANUFACTURING COMPANY

Finderna Plant, Somerville, New Jersey

Telephone: Randolph 5-2200

*A Trademark of THE SINGER MANUFACTURING COMPANY

†A Trademark of THE DIEHL MANUFACTURING COMPANY

Induction Generator for Gas-Ionization Research and Plasma-Torch Work

A 40-megacycle Ther-Monic induction generator for metallurgical research work, capable of continuous operation at 3-kw output, is now commercially available from the Induction Heating Corporation, Brooklyn, N. Y. Originally developed by Ther-Monic for the Argonne National Research Laboratories in Chicago, Ill., this equipment is able to achieve extremely shallow case depths in hardening steel, and thin materials can be joined with a minimum of power and distortion. As an example, depth of penetration at 40 megacycles is 0.0005 inch, compared to 0.0017 inch at 4 megacycles and 0.0055 inch at 400 kilocycles.

One of the recently publicized applications of gas ionization produced by frequencies in this range is the plasma torch. Intense heat is developed in a rapidly moving column of ionized gas which can be directed in the same manner as a torch. High-resistance materials, such as semi-conductors, can be readily heated. Ceramics and glasses of certain compositions can be induction-heated if raised in temperature by a susceptor.

Despite the machine's versatility, it is a compact unit with oscillator circuits and components designed for reliability in use from "no load" to "full output." The grid current is adjustable externally, and output is adjusted by a Variac.

The three-phase power supply has a filter that produces almost pure direct current. A special design of output transformer isolates the work-coil from the oscillator and precisely steps down the voltage to the work-coil. The major components and tubes are identical to those used in Ther-Monic's "B" series generator in the standard frequency range.

Circle 588 on Readers' Service Card

Positioning Control System

A point-to-point positioning control system, called Rapac, has been developed by the Square D Co., Milwaukee, Wis. Providing accuracy to plus or minus 0.001 inch and repeat accuracy to plus or minus 0.005 inch, this system directs the positioning operations on a wide variety of machine

tools, including drill presses and boring mills. It is also suitable for multiple-axis control. Punched tape is used for predetermining sequences.

The new system, introduced at the recent Production Engineering Show, features a unique linear transducer which is subject to neither wear nor deterioration. The transducer indicates the direction of travel toward the desired positioning point.

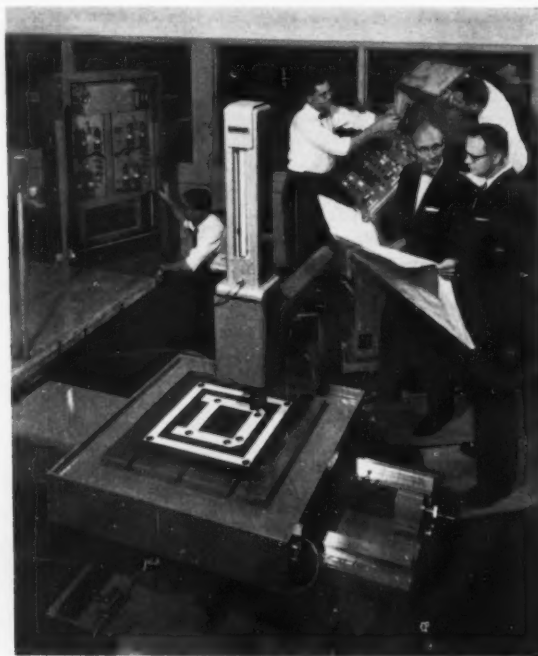
The system does not require special machine designs. It will operate with virtually any precision machine tool or device requiring accurate positioning. Square D static components and encapsulated building-block circuitry are used wherever possible to reduce and simplify maintenance. Accuracy is not dependent on screws, racks, pinions, or other parts subject to wear.

Rapac is available as a complete system or in components for measuring subsystems, drive subsystems, and data decoding subsystems. These components include the Square D Type A-S adjustable-speed drive, linear transducer, phase detector, command transformer, power supply, and Norpak static decoding system.

Circle 589 on Readers' Service Card



Ther-Monic 40-megacycle induction generator

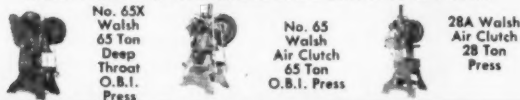


Square D Rapac positioning control system

AMERICAN GAGE AND MACHINE COMPANY MILITARY AND INDUSTRIAL PRODUCTS



WALSH PRESSES WITH VARIABLE SPEED DRIVES TO 500 R.P.M.



260 V.O.M. Expands as the need arises by use of adapters



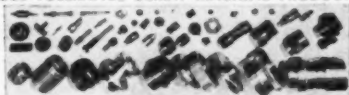
In addition to the Dry Type Transformer which may be installed in your plant, STANDARD makes a complete line of POWER, DISTRIBUTION, INSTRUMENT AND SPECIALTY Transformers for the Machine Tool Trade.

Two-stage automatic horizontal compressor • OEM-38-60 sizes from 1/4 hp to 20 hp;



stationary or portable; upright or horizontal; electric or gasoline.

CLOSE TOLERANCE SCREW MACHINE PRODUCTS



AUTOMATION EQUIPMENT—MACHINERY & ASSEMBLIES • PRODUCT DESIGN—HYDRAULIC, PNEUMATIC & ELECTRO MECHANICAL • TESTING EQUIPMENT—DEPARTMENT OF DEFENSE—ORDNANCE AND GROUND HANDLING EQUIPMENT.

To Bureau of
Inspection Service



Standards Accuracy
for Industry

World-famous maker of the finest mass production woodworking machines. Offers a complete line of precision built equipment for the industry, including molders, tapeless veneer splicers and joiners, sanders, production saws, cutters and cutter grinders, and nailing machines.

SIZE CONTROL CO.

2500 W. Washington Blvd.
Chicago 12, Ill. Area
MOntroe 6-6710 Code
312

WALSH PRESS AND DIE CO.

4709 W. Kinzie St. Area
Chicago 44, Ill. Code
ESTebrook 8-6700 312

SIMPSON ELECTRIC CO.

5200 W. Kinzie St. Area
Chicago 44, Ill. Code
ESTebrook 9-1121 312

STANDARD TRANSFORMER CO.

Warren, Ohio Area
EXpress 2-1563 Code
"wherever there is power" 216

CHAMPION PNEUMATIC MACHINERY CO.

825 Pleasant St.
Princeton, Ill.
Phone 3-1215

AFFILIATED SCREW PRODUCTS

3800 Wesley Terrace Area
Schiller Park, Illinois Code
GLadstone 1-1940 312

COLUMBIA RESEARCH AND DEVELOPMENT CORP.

4608 Indianola Ave. Area
Columbus 14, Ohio Code
AMhurst 7-1277 112

THE MIDWEST GAGE LABORATORY

2500 W. Washington Blvd. Area Code
Chicago 12, Ill. MOntroe 6-6710 312

G. M. DIEHL MACHINE WORKS

Wabash, Indiana
563-2102 Area Code 219

1. PANEL METERS

AC and DC Ranges

2. METER RELAYS

Front Adjustable

3. TEST EQUIPMENT

Portable and Laboratory Type,
Radio, TV Combustion, Analyzing
Equipment

4. PLUG GAGES

Reversible Plain and Thread

5. PLAIN AND THREAD RINGS

6. SPECIAL GAGES

7. CENTERLESS LAPPING MACHINES

8. DEEP THROAT PUNCH PRESSES

Up to 65 tons

9. TRANSFORMERS

Power
Distribution
Instrument
Specialty

10. AIR COMPRESSORS

11. WATER PUMPS

High Pressure

12. MACHINERY

Woodworking
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Tire Recapping
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13. CASTINGS

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Aluminum to 40 lbs.

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& Launching
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For Product Quality Control

16. SCREW MACHINE PRODUCTS

From 1/32" to 4-1/2" diameter
Machining of Castings & Forgings
to 3-1/2" diameter

AMERICAN GAGE & MACHINE COMPANY

5200 W. Kinzie St., Chicago 44, Ill.

- 1-3 ☐ Panel Meters, Meter Relays, Test Equipment, Radio, TV . . . SIMPSON ELECTRIC CO., CHICAGO, ILL.
- 4-7 ☐ Plug Gages, Plain & Thread Rings, Special Gages, Centerless Lapping Machines . . . SIZE CONTROL CO., CHICAGO, ILL.
- 8 ☐ Deep Throat Punch Presses . . . WALSH PRESS & DIE CO., CHICAGO, ILL.
- 9 ☐ Transformers . . . STANDARD TRANSFORMER CO., WARREN, OHIO
- 10-11 ☐ Air Compressors, Water Pumps . . . CHAMPION PNEUMATIC MACHINERY CO., PRINCETON, ILL.
- 12 ☐ Machinery . . . G. M. DIEHL MACHINE WORKS, WABASH, IND.
- 13 ☐ Castings . . . INDIANA MACKAY FOUNDRY CORP., MUNCIE, IND.
- 14 ☐ Design-Fabrication & Testing Prototypes . . . COLUMBIA RESEARCH & DEVELOPMENT CORP., COLUMBUS, OHIO
- 15 ☐ Master Gage Inspection . . . THE MIDWEST GAGE LABORATORY, CHICAGO, ILL.
- 16 ☐ Screw Machine Products . . . AFFILIATED SCREW PRODUCTS, SCHILLER PARK, ILL.

For additional information, check item(s)
desired and mail coupon to above address

ALL ENDS OF PARTS
Completely Finished
"1-2-3"
 ON THE
GOSS and DeLEEuw
Automatic Chucking Machine
 in **1 SET-UP**

This recent Goss & DeLeeuw development has already received universal acclaim as an outstanding achievement.

In speed, ease of tooling and precision finishing, the "1-2-3" chucker provides engineering advantages which result in vastly greater production at a fraction of parts' costs by other methods.

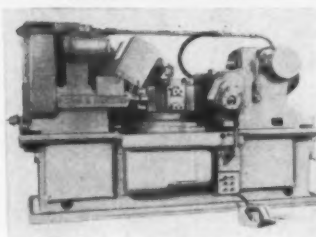
Easy, fast change-over from job to job makes this machine ideal for short-run requirements. Sturdy construction, power and speed make its advantages apparent on long runs.

"1-2-3" means ability to handle work requiring machining operations on one, two or three ends simultaneously or in sequence—a method exclusive with Goss & DeLeeuw and offered on this machine.



Illustrated literature available promptly on request. Send samples of your work for time and cost estimates.

GOSS and DeLEEuw
 MACHINE COMPANY, KENSINGTON, CONN., U.S.A.

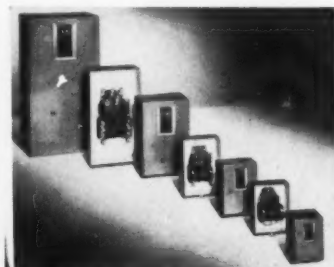


Allen-Bradley Motor Starters

A complete line of new Bulletin 709 across-the-line motor starters—designed to meet today's critical requirements for greater reliability, increased mechanical life, and smaller size—has been announced by the Allen-Bradley Co., Milwaukee, Wis. This line is offered in seven starter sizes—00 through 5—with maximum ratings from 1 1/2 hp, 220 volts; 2 hp, 440 to 550 volts up through 100 hp, 220 volts; and 200 hp, 440 to 550 volts.

These starters employ the same "one-moving-part" solenoid principle used in the present Allen-Bradley starters. However, the design is entirely new, and both size and weight have been drastically reduced, especially in the higher ratings. Both the mechanical life and electrical reliability of the new starters are said to far exceed those of the previous designs.

New double-break contacts of an improved, cadmium-oxide silver resist welding. The contacts are so shaped that they seat squarely upon closing, without wear-causing twisting or sliding. Totally enclosed arc chambers confine the arc, limiting ionization and the resulting heat, and greatly increasing current-interrupting capacity. A new material for the arc hood and a new hot-molding process result in greater mechanical strength and dimensional accuracy. Also, this new material has unusual arc-quenching properties and is highly resistant to arc tracking. Metal-arc quenchers are used with Size 2 and larger starters to cool the arc and increase the interrupting capacity.



Complete line of solenoid starters announced by Allen-Bradley Co.

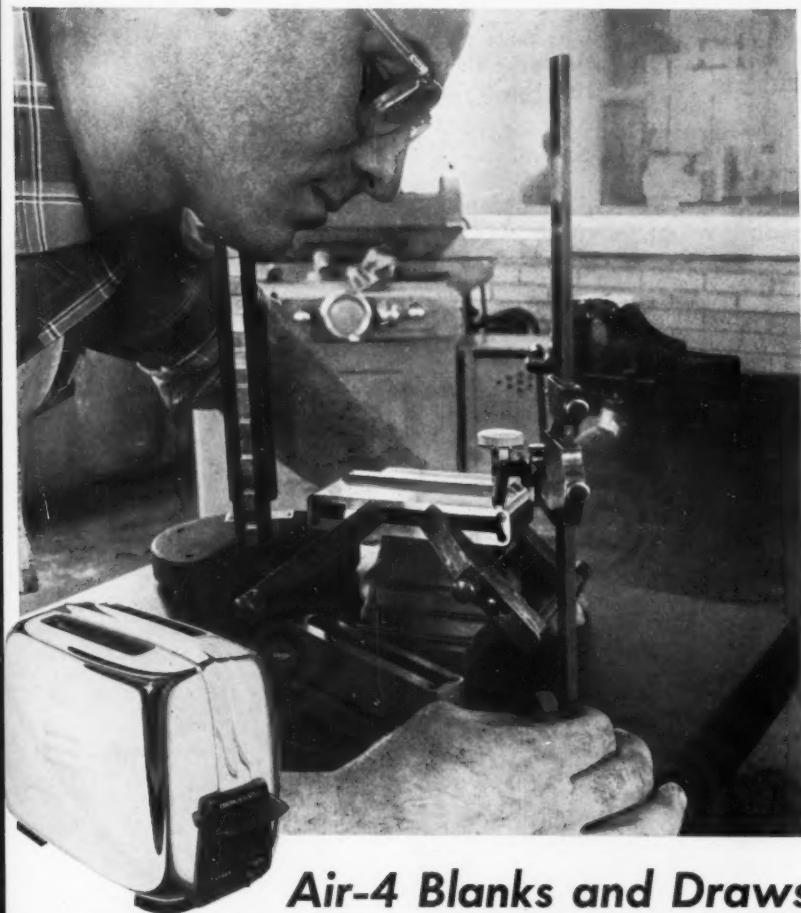


for Strength
... Economy
... Versatility

Tool Steel Topics



BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
Export Sales: Bethlehem Steel Export Corporation



Air-4 Blanks and Draws Bread Slots in GE Toaster Shell

This blanking and drawing die, made from Bethlehem Air-4 tool steel, forms bread slots in .030-in. steel sheet for a General Electric automatic toaster. Hardened to Rockwell C 59, the die sections were made by Yarema Bros. Tool & Die Co., Allentown, Pa. They were pleased with Air-4 for two reasons—minimum distortion during heat-treatment, and easy machinability.

Hardens in Air at 1550 F

One of the big advantages of Air-4, Bethlehem's new free-machining me-

dium-alloy tool steel, is its ability to harden in air at low temperature—about 1550 F. Air-4 has exceptional free-machining characteristics because just the right amount of lead has been added. It has high wear-resistance, excellent toughness, and deep-hardening properties—everything you need for economical tool service.

Our booklet on air-hardening steels includes full data on Air-4. For your copy, write to Publications Department, Bethlehem Steel Company, Bethlehem, Pa. Ask for Booklet 548.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

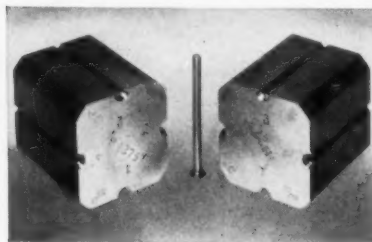


Lehigh H Is the Work-Horse Of the Cold-Extrusion Industry

Bethlehem's Lehigh H, a high-carbon, high-chromium (AISI type D-2) tool steel, is the most widely used tool steel in the cold-extrusion industry. And for good reasons. Lehigh H has an unusually good combination of properties: high compressive strength, deep hardenability, and high resistance to wear.

Lehigh H is used for a wide variety of cold-extrusion tools, such as punches and mandrels which are subject to compressive loads or abrasion. Whenever it is used for containers, bushings, or similar parts which are subjected mainly to tensile loads, it is supported by an external shrink ring.

Cold-extrusion tools of Lehigh H are usually made to a hardness of Rockwell C 58-60. Occasionally they are tempered back to C 55 to avoid breakage. Using a hardness above C 60 is not recommended, because such a hardness is obtained only at a sacrifice of proper tempering.



COLD-HEADING DIE STEEL SPEEDS HEADING OF SCREW BLANKS

These gripper dies are used by Southern Screw Company in forming blanks from steel wire. The dies, made of Bethlehem Cold-Heading Quality tool steel, produce about 150,000 blanks before redressing is required. Bethlehem Cold-Heading steel resists shock because it is carefully controlled for hardenability. It also has a carbon range selected to give good wear-resistance and high toughness.

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Quality
and
Economy
Use**

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For Service Contact...

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Connecticut Malleable Castings Co., New Haven 6
Eastern Malleable Iron Co., Naugatuck

DELAWARE

Eastern Malleable Iron Co., Wilmington 99

ILLINOIS

Central Fdry. Div., Gen. Motors, Danville
Chicago Malleable Castings Co., Chicago 43
Moline Iron Works, Moline
Moline Malleable Iron Co., St. Charles
National Malleable and Steel Castings Co., Cicero 50
Peoria Malleable Castings Co., Peoria 1
Wagner Castings Company, Decatur

INDIANA

Albion Malleable Iron Company,
Muncie Division, Muncie
Link-Belt Company, Indianapolis 6
National Malleable and Steel Castings Co., Indianapolis 22

IOWA

Iowa Malleable Iron Co., Fairfield

MASSACHUSETTS

Belcher Malleable Iron Co., Easton

MICHIGAN

Albion Malleable Iron Co., Albion
Auto Specialties Mfg. Co., Saint Joseph
Cadillac Malleable Iron Co., Cadillac
Central Fdry. Div., Gen. Motors, Saginaw

MINNESOTA

Northern Malleable Iron Co., St. Paul 6

MISSISSIPPI

Mississippi Malleable Iron Co., Meridian

NEW HAMPSHIRE

Laconia Malleable Iron Co., Laconia

NEW YORK

Acme Steel & Malleable Iron Works, Buffalo 7
Frazer & Jones Company Division
Eastern Malleable Iron Co., Solvay
Oriskany Malleable Iron Co., Oriskany
Westmoreland Malleable Iron Co., Westmoreland

OHIO

American Malleable Castings Co., Marion
Central Fdry. Div., Gen. Motors, Defiance
Dayton Malleable Iron Co., Ironton Div., Ironton
Dayton Malleable Iron Co., Ohio Malleable Div., Columbus 16
National Malleable and Steel Castings Co., Cleveland 6

PENNSYLVANIA

Buck Iron Company, Inc., Philadelphia 22
Erie Malleable Iron Co., Erie
Lancaster Malleable Castings Co., Lancaster
Lehigh Foundries Company, Easton
Meadville Malleable Iron Co., Meadville
Pennsylvania Malleable Iron Corp., Lancaster

TEXAS

Texas Foundries, Inc., Lufkin

WEST VIRGINIA

West Virginia Malleable Iron Co., Point Pleasant

WISCONSIN

Belle City Malleable Iron Co., Racine
Chain Belt Company, Milwaukee 1
Federal Malleable Company, Inc., West Allis 14
Kirsh Foundry Inc., Beaver Dam
Lakeside Malleable Castings Co., Racine
Milwaukee Malleable & Grey Iron Works, Milwaukee 46

**These companies are members
of the Malleable Castings Council**

The starters incorporate a patented, high-efficiency magnet having two "working" pole faces, which make them unusually powerful for their size and weight. The magnet yoke and coil are set in a large die-cast aluminum mounting, which serves to dissipate the heat of the coil rapidly and maintain a low operating temperature. The permanent air

gap is completely disassociated from all wearing parts so that any pole-face wear cannot reduce the air gap and thereby bring about "magnetic sticking." By incorporating a positive snap action, contact chatter is effectively eliminated. Any voltage which will pick up the magnet will pull it through to the sealed position.

Circle 590 on Readers' Service Card

**Burgmaster Turret Drills Equipped
with Sperry Tape Controls**

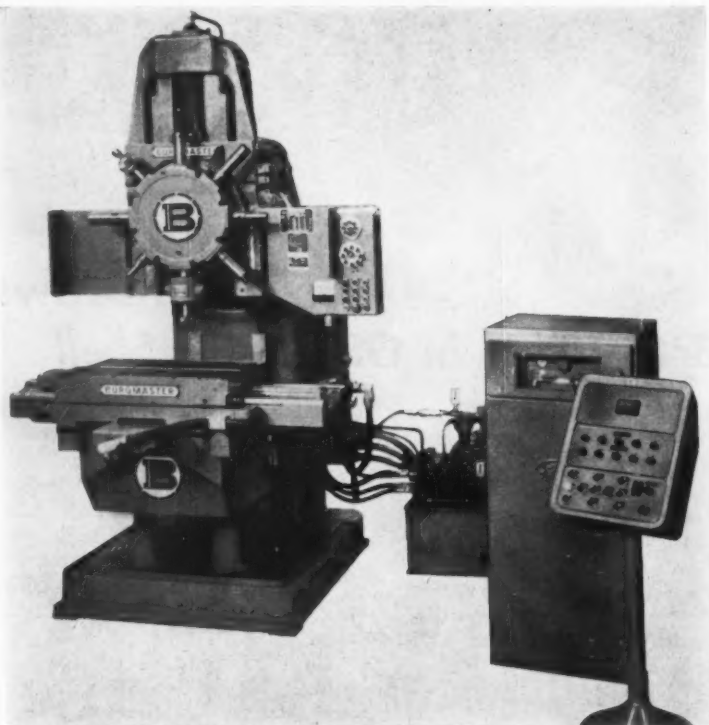
The Sperry Gyroscope numerical-control system is now available on the line of six- and eight-spindle turret drilling machines manufactured by the Burgmaster Corporation, Gardena, Calif. This announcement brings to ten the number of numerical-control systems offered by different manufacturers for automatic operation of Burgmaster turret drills.

The Sperry system employs linear coil transducers to pinpoint the measurements that determine the final X-Y positions of the table. Table positioning, by hydraulic cylinders, is fast and smooth. The accuracy is unaffected by any

slight mechanical anomalies that may be introduced by the transport mechanism, and is held within 0.0005 inch over the entire table length.

The pedestal-mounted operator's panel also contains manual input knobs that permit the operator to set X-Y axes dimensions during setup, inspecting, or the handling of "on-off" jobs. The tape reader is placed in the compact control cabinet, which is 23 by 18 by 65 inches high.

No computer is required to program the job for tape preparation. It takes about one minute per hole to program the job, one minute to



Burgmaster turret drill equipped with Sperry numerical control

Circle Page Number on Readers' Service Card

Post-Forming: New Way to Bigger Savings with Malleable Castings

The ductility of Malleable iron castings permits use of high-speed forming techniques to finish Malleable parts at lower cost. Take advantage of the versatility you get

only with ferritic and pearlitic Malleable castings. For a fuller understanding of how Malleable can help you, call any producer that displays this symbol —



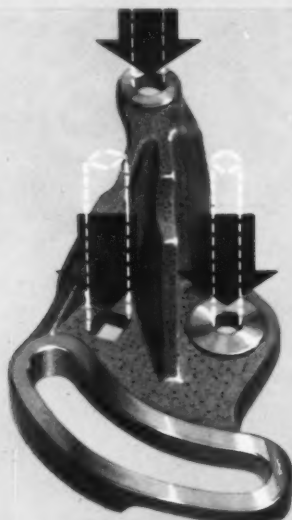
Free Folder describing these techniques is available for your use. Just ask any member of the Malleable Castings Council for Data Unit No. 116, or write to Malleable Castings Council, Union Commerce Building, Cleveland 14, Ohio.



Hot Form It — Hot coining this Malleable transmission part reduces finished cost . . . eliminates three cutting operations required by the previously used steel part.



Roll It — Oil grooves in lawnmower crankshafts and splines in compressor crankshafts are just two of many places where rolling proves more economical than machining.



Punch It — Holes with diameters greater than the thickness of the metal can be punched in Malleable. Two round holes and a square hole are punched simultaneously in this idler arm.



Spin It — Malleable's ductility permits the sleeve and end disc in this ball joint to be held in place by spinning the Malleable housing into a strong, permanent flange.



STOP DISCARDED CUTTING OIL LOSSES!

A "Cleartex Cure" ends the cutting oil dilution problem forever...cuts per-piece production costs as much as 40%

In spite of precautions, lube oil dilutes the cutting oil in up to 70% of all automatics. This dilution can mean substantial losses in discarded oil. Worse yet—diluted cutting oil can be even more costly in terms of shortened tool life...increased downtime...a higher percentage of rejects.

Cleartex—triple-purpose oil. In every instance a "Cleartex Cure" eliminates these losses instantly because Texaco Cleartex works in *both* the cutting *and* lubricating sumps of all your automatic screw machines. Acts as a hydraulic fluid, too. The "Cleartex Cure" can cut your per-piece production costs as much as 40%.

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Cleartex. Chances are, a "Cleartex Cure" can net you considerable savings.

Send for free booklet. Our illustrated booklet, "Cleartex in Automatic Screw Machines" gives full details on how diluted cutting oil may be eating into your profits. To get your copy, plus a survey of your automatics, contact your nearest Texaco distributor—or write Texaco Inc., 135 East 42nd Street, New York 17, N. Y., Dept. MA-101.

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punch forty-five holes in the tape, and three to five minutes per tool to set up the machine.

Burgmaster six- or eight-spindle tape-controlled turret drills are made in capacities for drilling

holes from 3/4 to 1 1/2 inches in diameter in steel. Individual spindle speeds, feeds, and depths of cut are preselective and are shifted when the turret indexes.

Circle 591 on Readers' Service Card

Automatic Machine Equipped with Diamond Tools for Processing Ferrite Part

A fully automatic machine brought out by Rehnberg-Jacobson Mfg. Co., Rockford, Ill., is equipped with an R-J 30-inch diameter index-table for processing a ferrite part. The machine rough and finish diamond-reams a 0.295-inch diameter hole and diamond face-grinds a 0.590-inch diameter boss on the face of a ferrite part. Two ferrite work-pieces are automatically fed from a magazine and clamped in the fixture.

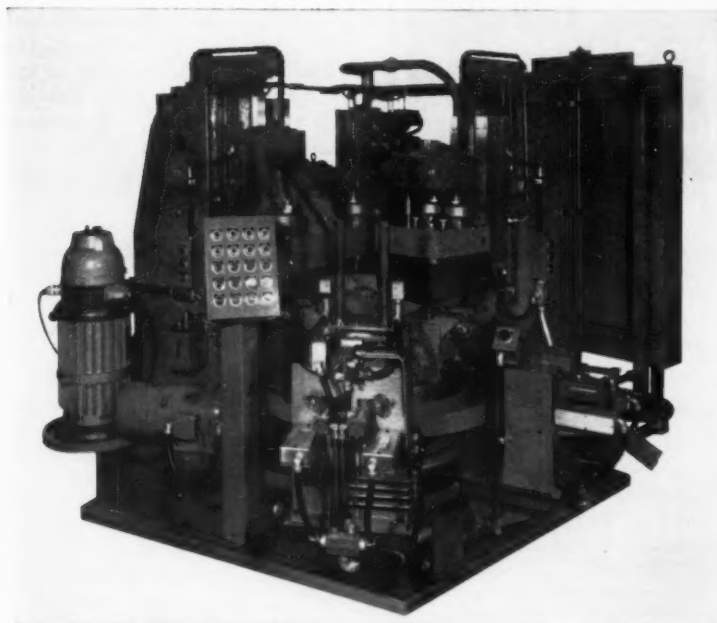
There are four high-cycle spindles mounted on a 10-inch R-J way type hydraulic slide to provide for the traverse and feed. Two spindles are arranged for rough diamond reaming of the holes in each of the two parts, and the other two spindles for the finish reaming or sizing of the holes in each part. The four super-cycle reaming spindles operate with a single-speed converter to run the spindles at a speed of 28,800 rpm.

For the diamond face grinding of the ferrite part, only one grinding pass is required. The two spindles used for this operation are also operated at 28,800 rpm from a separate single-speed converter. They are mounted on a 10-inch R-J way type hydraulic unit to provide the required traverse and feed.

The grinding spindles are also arranged to oscillate during the grinding cycle and are located in eccentric bushings, with the oscillating motion of the spindles provided from a drive gear-box.

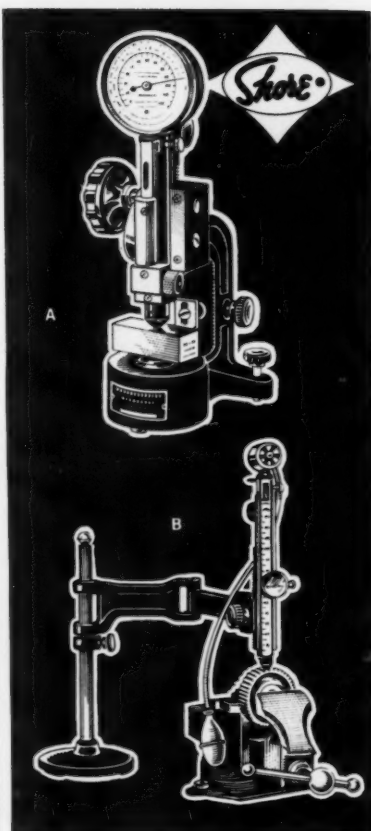
After the machining operations are completed, the parts are automatically unclamped and ejected from the machine. The total cycle time of the machine is arranged for ten seconds, and with two parts per fixture, production of the machine is established at 720 pieces per hour at 100 per cent efficiency.

Circle 592 on Readers' Service Card



Rehnberg-Jacobson automatic equipped to process ferrite part

MACHINERY, July, 1961



HARDNESS TESTING

Shore's Improved Direct Reading Scleroscope and Standard Recording Scleroscope with dial graduated in standard Scleroscope and equivalent Brinell and Rockwell "C" Hardness Numbers, are able to perform over 1000 hardness tests per hour. Both Scleroscopes are completely portable, operative on all types and sizes of metals, are reliable in hands of non-technical help, and show no visible injury signs on finished surfaces. Write for free brochures on these instruments.

A Standard Recording Scleroscope with Clamping Stand, jaw capacity 3" high x 2 1/2" deep. Supplied with following accessories: diamond hammer, hard and soft test block, V block for testing rounds, and steel carrying case.

B Direct Reading Scleroscope shown above with special Swing Arm & Post Assembly. Height capacity 9", reach 14". To be mounted on bench for testing large objects. Supplied with two test blocks and diamond hammer.

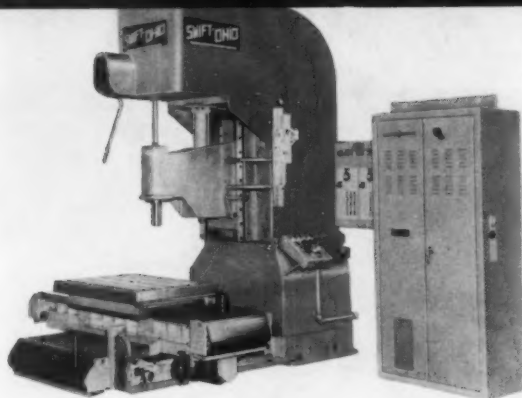
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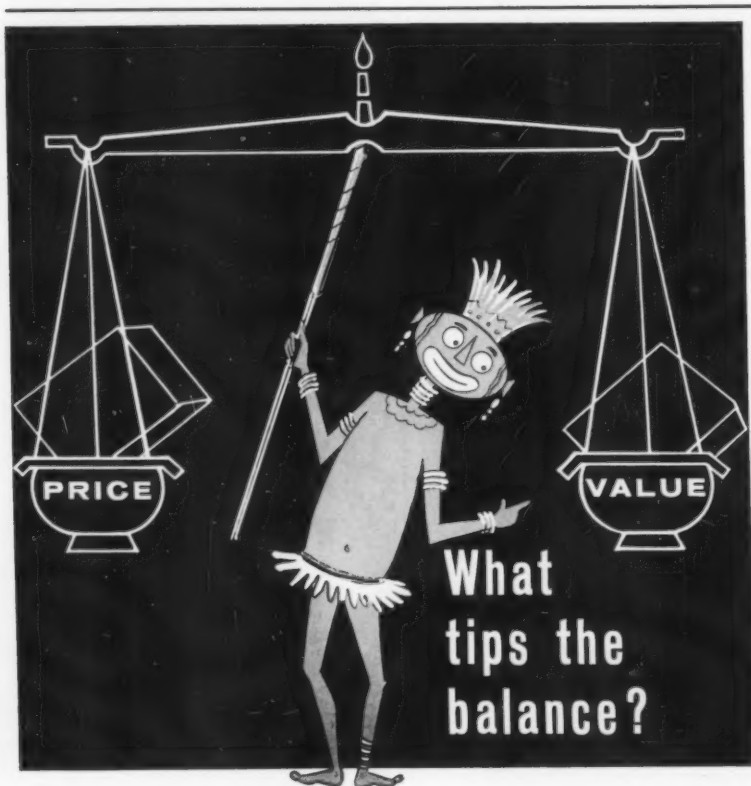
Circle Page Number on Readers' Service Card.



Yates-American machine for polishing sheet materials



Swift Ohio automatic or manually controlled drill



Our customers know that buying on quality pays off! They've weighed the price (sometimes a few cents more) against WHAT REALLY COUNTS. They've found cost-per-piece of drilled parts consistently lower and upkeep expense invariably less with U.S. multiple spindle heads. They've found that quality materials and workmanship back up sound design in every U.S. head. **US** Unrealistic pricing and price cutting can lead only to product degeneration. Our customers know that **buying on quality pays off.** They've proved it many times!

UNITED STATES DRILL HEAD COMPANY
5298 River Road • Cincinnati 33, Ohio



Adjustable and Fixed Center Multiple Drilling Heads — Individual Lead Screw Multiple Tapping Heads — and Fixtures.

Upright Heavy-Duty Drill

A No. 425 upright heavy-duty drill representing a new approach to program control in that drilling, boring, tapping, and positioning can be automatically or manually controlled has been announced by the Swift Ohio Corporation, Kenton, Ohio. The machine's versatility adapts it for a wide range of production applications as well as job-shop and maintenance-department work. It eliminates the need for extensive setup, jigs, fixtures, and large inventory storage. The drill has a numerically controlled 24- by 36-inch compound table, hydraulic feed to spindle, eighteen spindle speeds ranging from 52 to 2250 rpm, and fine- and coarse-feed range provided by quick-change, two-speed gear range.

In addition to its General Electric Mark II numerical positioning control with 3/4-hp drive to each table movement, the machine shown features the complete manual control and manual decade positioning that make possible its wide range of practical application. Repeatable electrical accuracy of the automatic control is plus or minus 0.0005 inch.

Circle 593 on Readers' Service Card

Automatic Polishing Machine for Sheet Materials

A Model S-101 automatic polishing machine, announced by Yates-American, Beloit, Wis., is a high-production machine especially designed to obtain superior finishes on sheet type materials at low costs. The polishing operation is accomplished with an oscillating and rotating wheel drum made of

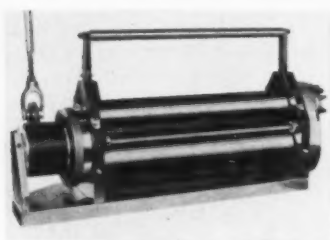
abrasive-impregnated nylon. Selected grade of abrasive, variable oscillating motion of the drum, and adjustable feed rate are said to provide the broad range of conditions with light abrasive action required to produce the most desirable precision-controlled finishes.

The abrasive wheel drum is positioned over the work for maximum ease of adjustment. It is quickly and easily removed for changing grade or renewing the abrasive. Lowering and raising of the drum by actuated air cylinder is controlled by an automatic sensing device, providing precision abrasive-to-stock contact. Oscillation of the drum is infinitely variable from 0 to 200 oscillations per minute with 3/8-inch lateral movement. A built-in dresser facilitates truing or cleaning the abrasive drum. Feed-rate ranges from 20 to 69 fpm. Two machine models accommodate widths of stock to 51 and 61 inches and in thicknesses up to 3 inches.

Circle 594 on Readers' Service Card

Precision Roll Feed

The Benchmaster Mfg. Co., Gardena, Calif., has introduced a new Series 9 PRF precision roll feed with roller lengths suitable for 15-inch stock widths. This roll



Benchmaster precision roll feed

feed has an adjustable stroke of 0 to 9 inches. The exceptional stroke length is obtained with a set of fully enclosed gears. The feed is reversible and incorporates Benchmaster's new roller cam clutch in double width. This clutch is designed to provide unusual repeat accuracy and freedom from wear. Ample contact area is provided by the double-width brake, which

can be adjusted during operation to provide the correct resistance required for accurate feeding and smooth performance.

The bottom feed roller is 3 7/8 inches in diameter and is made completely hollow to reduce inertial lag and momentum, thus permitting operating speeds up to 200 strokes per minute. Heavy roll pressure is maintained by spring load to insure positive, non-slip feeding. Roll lifters are actuated by the roller bar across the top. The actuating bar swings 180

degrees to either side when in the operating position. The feed can be operated with or without a bellcrank, which is available as an accessory.

Other model variations of the Benchmaster 9 PRF roll feed are supplied on special order for even greater stock widths. Series 3.5 PRF, similar in all other features to the Series 9 PRF, is furnished without gearing and provides adjustable stroke lengths up to 3.5 inches.

Circle 595 on Readers' Service Card

INSPECTION PROJECTOR MAGNIFIES FOR [®] QUALITY...

Our inspection projector magnifies cutting edges to eliminate the minute angular deflection that could cause you costly production losses... just one of many inspections that account for Circle R quality.

CIRCLE R saws, slitters and combination center drills must submit to constant exhaustive inspection to work their way to you. They've got to prove they can ensure you correct cutting angles, long service, and minimal downtime.

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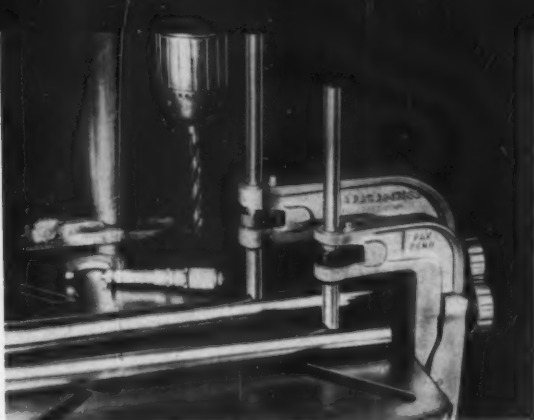
PROVIDENCE
Fred J. McMillen

ROCHESTER
James O. Horne

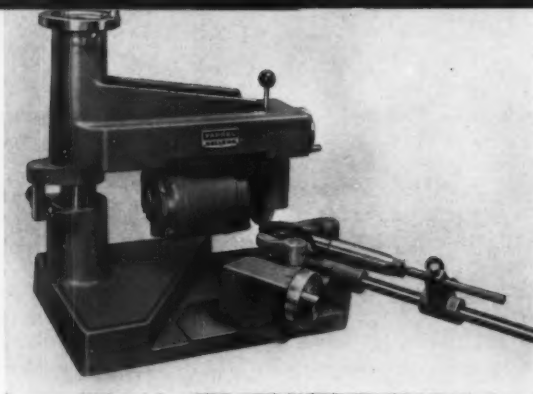



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Farrel-Sellers compact drill-point thinning machine



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The "mice" we're after of course, are the thousand-and-one special problems that plant engineers from all over the nation bring to us for solution. In missile, aircraft and general manufacturing, we're batting 1.000!

We think it's because we're "old timers" in this new field. We can solve your problem today because we solved one like it yesterday.

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Super-Precision Spindles have CONVERTED.

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STANDARD Super Precision Electrolytic Spindles are available in 50 to 3000 AMP Capacities.

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Deep-Throat Clamp

A deep-throat, threadless-spindle aluminum clamp, designed to nearly double the work-area accessibility at the clamping point, has been developed by the United Clamp Mfg. Co., division of United Screw Machine Products, Clearwater, Fla. The throat of this clamp approximates the height and retains all the unusual features of United's standard-frame clamps. The clamp is quick opening and closing. The threadless spindle readily slides to and locks on the piece to be pinned. A finger-tip control thumbscrew applies clamping pressure without frame distortion or without causing the spindle to turn and mar the work.

Deep-Throat clamps may be obtained with either anvil or V-spindles in carbon or stainless steel. In addition, solid beryllium-copper V-spindles are available for spatter-free welding. Currently available sizes are 4 by 4 inches and 6 by 6 inches.

Circle 596 on Readers' Service Card

Bench Type Drill-Point Thinning Machine

Farrel-Birmingham Co., Inc., Consolidated Machine Tool Division, Rochester, N. Y., has brought out a compact, bench type Farrel-Sellers drill-point thinning machine. This self-contained motor-driven unit will thin and center the points of 1/2- to 3-inch diameter drills in lengths up to 24 inches. The grinding wheel is mounted on the shaft of the motor. The drill is held at three points:

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DRILLS



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Clip and File

DRILLING TIPS YOU CAN USE

Select the Correct Helix

The spiral flutes of a twist drill perform three functions. They bring the chips out of the hole; provides the proper rake angle at the cutting lip; permit coolants to reach the point of the drill. These actions are vital. All are affected by the helix (the angle of spiral) of the flutes. Be certain that the helix you choose is the correct one for the material being drilled.

Regular Helix



This is the familiar style and the best helix for most general purpose shop work in steel, forgings, castings, and other ferrous materials. Where extra rigidity is required—as in portable drilling—select a regular helix drill with heavy duty construction.

Fast Helix



In general the fast helix is selected for drilling materials of low tensile strength like aluminum, magnesium, copper, and thermoplastics. These materials produce a large volume of chips and the low angle of incline of the flutes is specially suitable for their removal. Where chip removal is slowing drilling, the fast helix may solve the problem.

Slow Helix



This drill is generally used for materials that break up into very small or powdery chips...as occurs in drilling brass; hard rubber; thermo-setting plastics such as bakelite; fibre and plastic laminates. These drills are of light construction with wide flutes and are not usually suitable for heavy duty work.



USE
CHICAGO-LATROBE
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60

for the most complete listings of drills of all types—plus valuable advice on their use. INCLUDES PRICES.

by hardened jaws on the leading edges of the flutes, just back of the cutting edges, and by an adjustable center at the end of the shank. This three-point grip leaves the body of the drill entirely free of any contact with the chuck.

In operation, the machine grinds a groove of the proper depth on each side of the web. This reduces the length of the flat between cutting edges, which has a tendency to thicken as the drill wears. The drill is reset for each groove so

that its axis is always in the same position. The grinding wheel is set with relation to the axis of the drill to insure automatic concentricity of the web. Micrometer adjustment is provided for setting the grinding wheel height.

Jaws for positioning drills can be opened and closed quickly. One pair of jaws holds all drill sizes within the rated capacity. The machine occupies a bench space of 24 by 16 inches and has an over-all height of 24 inches. It

is equipped with a 1/2-hp motor having a rated speed of 3450 rpm for operation on either 220/440-volt, 60-cycle, three-phase circuits or 110-volt, 60-cycle, single-phase lighting circuits.

Circle 597 on Readers' Service Card

Buffalo Drilling Machine Available in Bench and Floor Models

A No. 20 drilling machine, recently announced by the Buffalo Forge Co., Buffalo, N. Y., features numerous engineering refinements designed to save time and production costs. This machine has a capacity for drilling 1-inch holes in mild steel. All controls are located for quick, easy access by the operator. The "start-stop" push-button switch is conveniently mounted on the front of the ma-



Buffalo No. 20 drilling machine

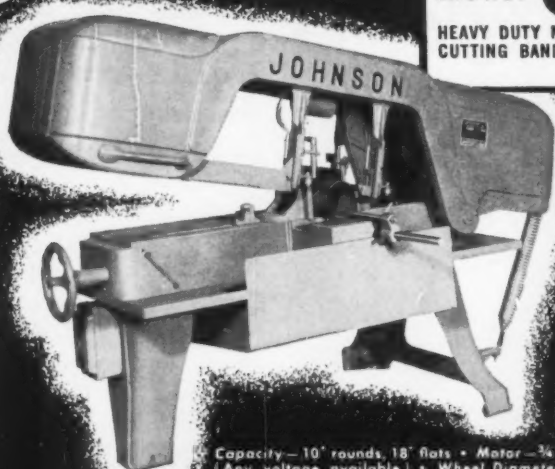
chine. A streamlined belt guard is hinged at the back of the machine for greater accessibility in changing belts. Five step pulleys in geometrical progression permit belt changing from step to step without adjusting the motor bracket.

The spindle-return spring can be adjusted by hand, without the use of tools. The depth-stop bar is equipped with an easily adjustable collar for either sensitive or power feed. Provision is made for adjustment of the feed sleeve. A device for clamping the frame on the column is of the split bushing

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model J
HEAVY DUTY METAL
CUTTING BAND SAW



Capacity—10" rounds, 18" flats • Motor—¾ hp
(Any voltage available) • Wheel Diameter—
16" • Floor Space—66" x 31" • Bed—11 wide,
44" long, 6" deep, 24" high • Overall Height
(closed)—39" • Weight—Approx. 750 lbs.
• Speeds—36, 90, 130, 190 feet per minute.

COMPARE the handsome, husky Johnson Model J with any metal cutting saw and here's what you'll find:

- Johnson leads the way in dependable, well-engineered, high performance band saws.
- A Johnson saw will cut anything in your stock pile, and do it faster.
- Johnson saws contain more exclusive construction and performance features that save time and money.
- Johnson saws are the finest metal cutting machines available anywhere—and, at the lowest price!

COMPARE... and see for yourself how easily you can save time, labor and production dollars with a Johnson saw. Complete information, prices—are yours for the asking.

Johnson MANUFACTURING CORPORATION
1016 BARNES ST., ALBION, MICHIGAN

Eastern Distributor
R. J. R. KELLY CO.
Hale Bldg., 51 Main St.
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Midwestern Distributor
W. O. LUNDMARK
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HASTINGS DISTRIBUTORS
1605 Solano Avenue
Berkeley, Calif.

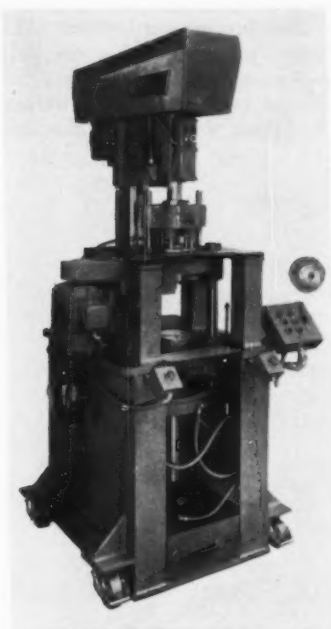
type. All ball bearings are of the permanent-seal, prelubricated type. A full 6-inch spindle travel is provided for either sensitive hand feed or power feed.

Available models include: floor drill; standard bench drill with tilting table; production bench drills having one to six spindles; and pedestal type drills, also made with one to six spindles. Options include power feed, variable-speed drive, and head-raising device. A table-raising device and production oil-trough table are available for bench or floor models.

Circle 598 on Readers' Service Card

Wisconsin Multiple-Tapping Machine Equipped to Process Die-Cast Part

A standard multiple-tap machine built by the Wisconsin Drill Head Co., Butler, Wis., has been modified and equipped to perform several operations on die-cast parts in one work cycle. The workpiece is a round zinc die-cast base



Multiple-tapping machine built by Wisconsin Drill Head Co.

for a food blender. The machining operations consist of facing the rim, tapping the four motor-mounting holes, and tapping the

four leg holes. The part is loaded into the nest, and when the palm buttons are depressed, the nest is rapid-traversed upward to the cutting head, which is powered by a 2-hp motor located to the left of the fixture. The part is clamped at the end of the rapid-traverse stroke and is then fed into the cutting (facing) head.

Upon completion of the feed stroke, the tapping unit is energized and the eight cored holes are tapped. When the lead-screw

tap unit returns to its starting position, the part is lowered to its loading position, where an ejector pin raises it to facilitate removal.

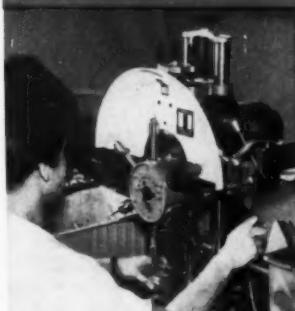
This machine produces 1920 parts per eight-hour day at 100 per cent efficiency. Safety provisions prevent the work cycle from starting if the part to be processed is not located properly in the nest. Equipment includes Wisconsin eight-spindle, fixed-center tapping head and floating tap-holders.

Circle 599 on Readers' Service Card

Burgmaster BENCH MODEL

TURRET DRILL

*Saves 89%
of Equipment Cost...
Increases Production
120% for Prest-o-matic*



JOB FACTS

Company:
Prest-O-Matic Company

Machine:
Burgmaster Bench Model
Turret Drill

Part:
Die Cast Aluminum Valve Body

Lot Size:
Continuous — 220 per day

Holding:
Special Fixture

Special Attachments:
2 Burgmaster "3000" Tapping
Heads

Production Rate:
Former Method:
4 Single Spindle Drills
Former Production:
Valve Bodies — drill 8 —
tap 3 holes — 100 per day

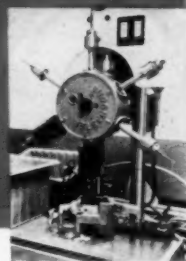
Present Method:
Burgmaster Bench Model
Turret Drill

Present Production:
Valve Bodies — drill 8 —
tap 3 holes — 220 per day

Production Increase:
120%

Other Advantages:
Less handling time, less
operator fatigue, 75% less
floor space

*Pays for itself
in Four Weeks—
Saves Handling Time,
Operator Fatigue and
Valuable Floor Space*



When the Prest-O-Matic Company, Santa Ana, California tooled up to drill 8 holes and tap 3 in their die-cast aluminum valve bodies, they selected a Burgmaster Bench Model Turret Drill to save 89% of original equipment cost, and increase production 120% over the output of 4 single spindle drill machines. Savings in production costs paid for the Burgmaster Bench Model in just 4 weeks of operation. Additional savings reported by Prest-O-Matic include less handling time, less operator fatigue, and a 75% saving in floor space.

Send for Literature



BURGMASER CORPORATION

Small Tool Div., Burg Tool Manufacturing Co., Inc.
13226 S. Figueroa St., Box 311, Gardena, Calif.
Phone: FAcully 1-3510 Phone, wire or write Dept. OA

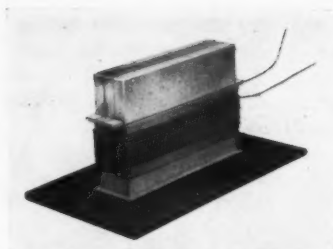
Omnimite Transducers for Sonic-Energy Cleaning Systems

Greater cleaning efficiency, substantial price reductions, and a lifetime guarantee are featured in a complete new line of Bendix sonic-energy cleaning systems announced by Sonic Energy Products, Pioneer-Central Division, Bendix Corporation, Davenport, Iowa. Omnimite, a magnetostrictive transducer, metallurgically bonded to a 1/4-inch thick 316-L

stainless-steel diaphragm, is a new achievement of Bendix research and is used exclusively in this new series of sonic cleaners.

Every Bendix Omnimite transducer-diaphragm assembly is guaranteed unconditionally not to break, crack, depolarize, deteriorate, become detached, or in any way cease to function for the lifetime of the cleaning unit.

Sonic-energy cleaning first was pioneered by Bendix as a means of achieving the critical cleanliness required for the precision



Bendix Omnimite transducer featured in the manufacturer's line of sonic-energy cleaning systems

PUSH BUTTON *Speed Selection* from to in seconds or to *any intermediate speed, instantly*

Just push a button and watch the large tachometer dial on the head-stock!

It's that easy!

The work is done by a motor driven speed changer. It accelerates or slows the lathe to any desired speed in seconds. With a 10:1 ratio, this new variable drive makes it easy to select from a wide range of speeds—200 to 2000 rpm in direct drive and 40 to 300 rpm in back gear.

Maximum stability and smooth

power transmission are assured because the drive unit is oversized. All pulleys and shafts are fully supported (eight bearings). Double V-belts throughout the drive eliminate slippage and deliver full power to the spindle. Because of this rigidity and extra pulling power, this lathe will take heavy cuts at all speeds and precision finish cuts at high speeds.

It is a precision lathe, moderate in price, with the versatility for toolroom, production or second operation jobs.

SHELDON *Variable Speed* PRECISION LATHES



Illustrated
WM56P
13" Swing-34" Centers

Write for
"Variable Speed"
Circular and General
Catalog showing . . .

10", 11", 13" and 15"

SHELDON

Precision Lathes
(Bench, Pedestal
and Cabinet types)

13" and 15"

SEBASTIAN
Geared Head
Lathes

SHELDON

Milling
Machines

SHELDON

Back Geared
Shapers

SHELDON MACHINE CO., INC.
4246 N. Knox Ave. • Chicago 41, ILL.

Dril-King Drilling and Tapping Machine

The Jarvis Corporation Machine Tool & Attachments Subsidiary, Middletown, Conn., has brought out a low-priced universal drilling and tapping machine



Jarvis Dril-King drilling and tapping machine

For strength
... economy
... versatility



NO LARGER GENERATOR SHAFT EVER FORGED ANYWHERE

Shipped recently to the General Electric Company's Large Steam Turbine Generator Department at Schenectady, N. Y., this shaft weighs 233,865 lb and measures 38 ft, 9½ in. long. The shaft will be machined and assembled by G. E. for a turbine-generator unit to serve Tennessee Valley Authority's Paradise Steam Generating Station at Paradise, Ky.

The 116-ton shaft was forged from a 120-inch diameter ingot that required the combined output of five electric-furnace heats, or roughly 260 tons of vacuum-poured, nickel-moly-vanadium steel. It was the largest ingot ever cast in a vacuum by Bethlehem. No larger generator shaft has ever been forged.

The generator shaft was fully heat treated and sonic tested. It has a maximum body diameter of 59¼ in.; minimum diameter of the forging is 11¼ in. The generator will operate at 1800 rpm, providing a maximum output of 391,111 kva.

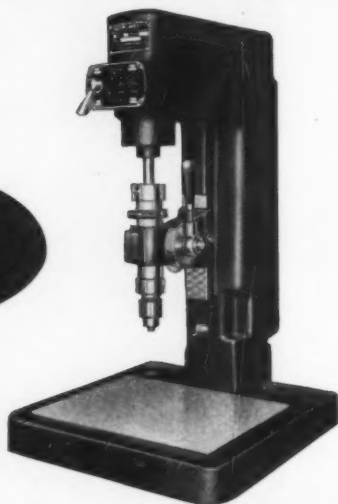
BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

Export Sales:
Bethlehem Steel Export Corporation

BETHLEHEM STEEL



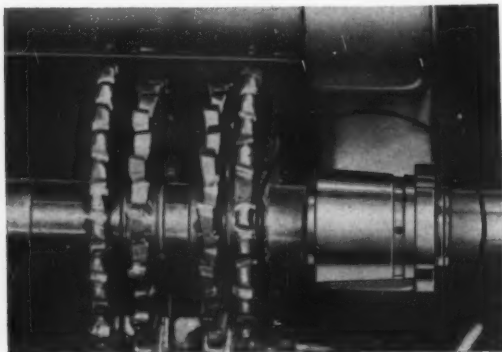
production drill for precision holes



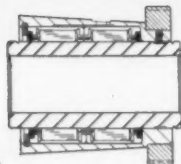
Let us show you how to knock hours off your production and precision drilling with this MA-8. Capacity to $\frac{3}{8}$ ". Eight spindle speeds with 10:1 range (variable speeds optional). Hand feed or air hydraulic. 12" swing. Column or bench type. One to six of our famous precision spindles, which give you quiet, vibrationless speeds up to 12,000 rpm. Send for Bulletin 857 or phone us. Avey, Box 1264, Cincinnati 1, Ohio.

For more data, circle Item 192A on Readers' Service Card

Replace the bronze bushing in your MILLING MACHINE ARBOR SUPPORT with a Sonnet ROLLER BEARING



- Faster speeds and feeds
- Maximum rigidity
- No chatter
- No bearing heating
- No bearing seizure
- No twisted arbors
- Longer cutter life
- Utilizes machine's lubrication system
- Increased production
- Better finishes
- Less maintenance
- Faster set-ups



Installed in minutes without machine rework. Requires no extra space; no adjustments. Extra sets of bushings provided to accommodate different size arbors. Permits full range of speeds and feeds of late model milling machines. Carbide cutters can be fully utilized.

Write for catalog.

SONNET

TOOL & MFG. CO. 580 North Prairie Avenue • Hawthorne, California

For more data, circle Item 192B on Readers' Service Card

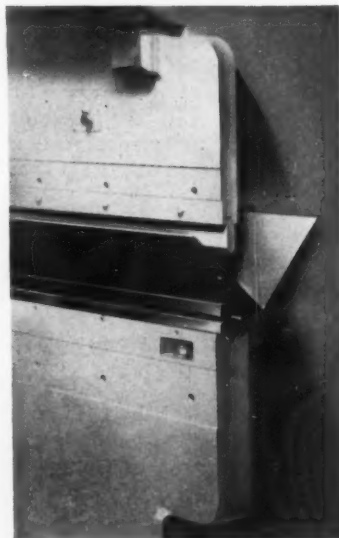
known as the Jarvis Dril-King. This self-contained compact machine is 66 inches high, including base. It is designed primarily for small-parts products, where small-hole drilling and tapping are required. The standard unit comes equipped with twelve spindle drivers and is able to drill holes to center distances down to $\frac{3}{8}$ inch minimum. Closer center distances are available with variations of the basic spindles. The work area on the standard model is 6 by $8\frac{1}{4}$ inches.

A feature is the vertical-feed work-table that brings the work up to the head rather than the head to the work. The unit is powered by a heavy-duty motor through a V-belt drive that provides for four speed changes.

Circle 601 on Readers' Service Card

Tufloy Press-Brake Dies

A press brake with Tufloy dies is available from Niagara Machine & Tool Works, Buffalo, N. Y. Unlike dies of surface-hardened carbon steel, Tufloy dies are uniformly strong all the way through. Extremely durable, and economical in a tremendous variety of bending and forming operations, these dies are made of heat-treated, stress-relieved, and machine-straightened tough alloy steel. Work surfaces are smoothly finished to cut friction and wear



Niagara Tufloy Dies

MACHINERY, July, 1961



Problem:

One Straight Cut...

One Miter Cut

Solution:

**One MARVEL No. 8
Band Saw**

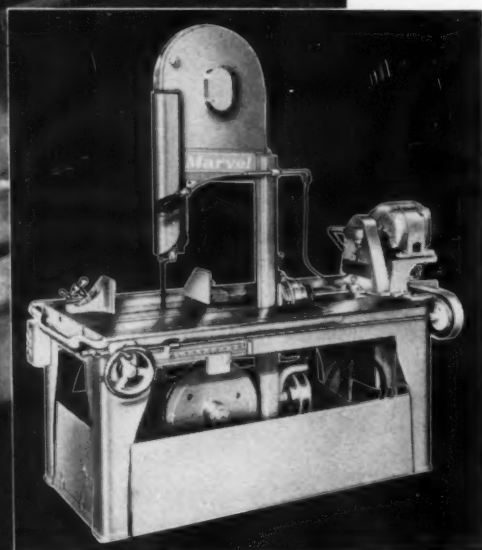
Recently, a MARVEL Field Engineer was called on to help solve a troublesome production sawing operation.

He found that a straight cut and a 45° miter cut were required on a 10" diameter pipe prior to welding it into an assembly. Production was slow, cutting costs were climbing to alarming proportions, and too many pieces were being rejected because one or both cuts were not meeting accuracy standards.

The trouble was easy to find. A makeshift arrangement was being used to do the job. After the straight cut was made, the miter was laid out and the pipe swung out into the aisle so that the saw could make the angle cut. Excessive work handling slowed production, valuable floor space was taken up, and accuracy became increasingly difficult to maintain.

Recommending a MARVEL No. 8 Universal Band Saw solved the problem. When the MARVEL Field Engineer showed how the Saw's column and blade can be tilted up to 45° right or left of vertical and fed straight into and through the cut at the pre-determined angle *while the work remained stationary on the table*, the production superintendent recognized the answer to his problem. He also saw, how the built-in protractor would eliminate all layout.

Result: another MARVEL No. 8 Universal Band Saw went to work for a new user.



Cutting miters quickly and accurately is just one of a hundred jobs that can be done on the versatile No. 8 Universal Band Saw ... the most useful—and used—metal cutting saw on the market. Get complete information on this time and cost saving band saw today. Write for Catalog 875.

**Marvel No. 8 Universal
Metal Cutting Band Saw**
Capacity: 18" x 18"

MARVEL *Metal Cutting* **SAWS**

**BETTER MACHINES
BETTER BLADES**

ARMSTRONG-BLUM MANUFACTURING CO. • 5700 Bloomingdale Avenue • Chicago 39, Illinois

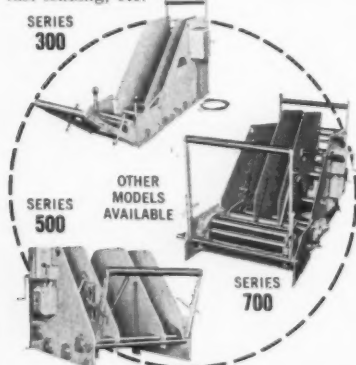
why pull against heavy coil weights

when it's so easy to draw from this slack loop!



Benchmaster Koil-Kradles form a slack loop from which any type of machine can effortlessly draw without pulling against the weight of a heavy coil! A complete range of Koil-Kradles sizes now cover coil capacities to 20,000 lbs. and stock widths up to 50 inches!

All Benchmasters are economically priced, yet contain such important features as Fully-Powered and Hardened Rolls, Anti-Friction Bearings, Strutted Frames, Fast Loading Pinch Rolls (standard equipment on many models), Variable Time Delay for reducing intermittency of operation, Adjustable Guide Plates, Reversible Motors for rewinding, Open Throats for fast loading, etc.



Also available: BENCHMASTER STRAIGHTENERS, KOIL-KRADLE-STRAIGHTENER COMBINATIONS, and COMBINATION FEEDING MACHINES.

WRITE FOR DESCRIPTIVE CIRCULARS on all Benchmaster press room equipment. Describe your job for personal recommendations!



benchmaster

World's largest manufacturer of steel punch presses and mills.

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Circle page number on Readers' Service Card

194

to a minimum and to keep dies from defacing the work. The symmetry of tongue and working faces about the vertical center line of the cross section is accurately maintained, thereby minimizing setup time when installing and changing dies. Because heat-treatment of Tufloy dies before and after reworking is not required, they can be reworked or modified without returning them to the factory. Commonly used

90- and 30-degree air bend dies, flattening and offset dies, three- and four-way dies, and 90-degree gooseneck punches are stocked in lengths of 2, 4, 6, 8, 10, and 12 feet. An average die, with working shut height of 5 1/4 inches, can be used with any standard press brake equipped with die-holder and ram adjustment. Special punches and dies are also available.

Circle 602 on Readers' Service Card

Glennite Ultrasonic Drilling Equipment

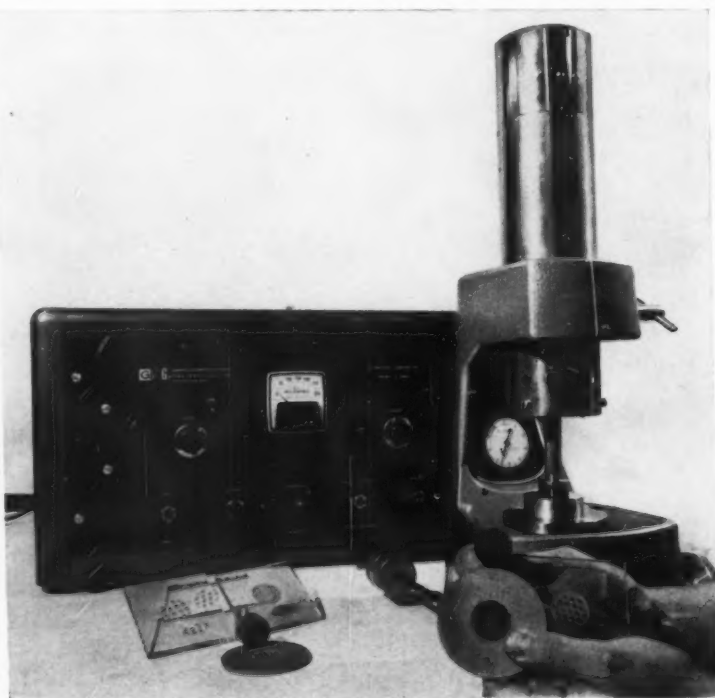
An improved Model D-101A Glennite ultrasonic drill introduced by Gulton Industries, Inc., Metuchen, N. J., is said to be nearly twice as efficient in performing multiple machining, slicing, cutting, and etching operations as the older model which it supersedes. The new drill will handle tool sizes up to 3/4 inch. Typical drilling rates per minute for different materials using this size tool are: glass, 0.200 inch; ceramic, 0.060 inch; ruby, 0.010 inch; ferrite, 0.030 inch; germanium, 0.050 inch; and tool steel, 0.008 inch.

Successful impact grindings

have been made with the new drill to produce delicate engravings in glass, gem stones, and mother of pearl, as well as accurate dicing of semiconductor materials. The new equipment drills holes as small as 0.002 inch in diameter in ferrites, ceramics, and tungsten carbide.

The drill efficiently machines white sapphire into instrument bearing blanks, drills holes in glass or ceramic insulators for electronic tubes, and machines port cavities in servomechanisms and holes in fiberglass reinforced epoxy resin.

Circle 603 on Readers' Service Card



Improved model ultrasonic drill introduced by Gulton Industries, Inc.

MACHINERY, July, 1961

Cincinnati H-V "Toolmaster" Milling Machine

A new turret type milling machine having a spindle head designed for horizontal milling with arbor-mounted cutters, and for vertical and angular milling with the spindle head swiveled and the arbor support removed, was recently announced by the Milling Machine Division of the Cincinnati Milling Machine Co., Cincinnati, Ohio. The new machine, known as H-V, is the latest addition to the company's "Toolmaster" line.

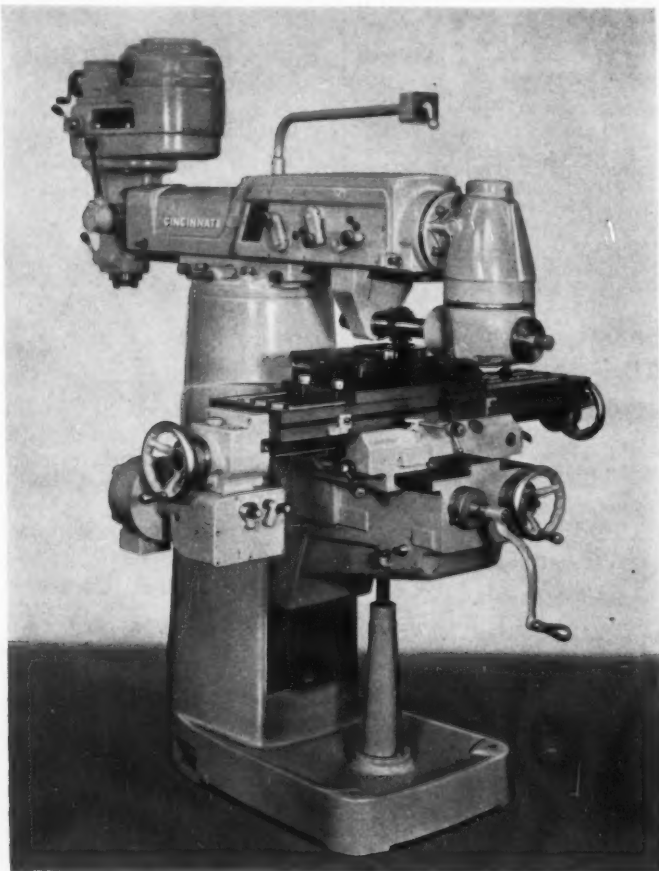
To save setup time, the machine may be equipped with any one of three different Toolmaster vertical heads on the opposite end of the overarm. Then, to quickly change from horizontal to vertical or angular milling, four bolts are loosened, and the overarm and turret base are swiveled as a unit to locate the vertical head over the table.

The Cincinnati Toolmaster line consists of five styles (1B, 1C, 1D,

1E, and H-V) differing primarily in the type of milling head and drive. All types are hand-feed machines, arranged to receive power table and cross-feeds as extra equipment. All have the sturdy square gibbed saddle-knee bearing; rectangular overarm mounted in a swivel turret on top of the column; built-in electrical controls and push buttons; extra-large micrometer dials for handwheels; oil-shot lubrication; and wide choice of attachments and extra equipment, including power feeds, index-head, shaping attachment, precision measuring equipment.

Features peculiar to individual styles of Toolmasters include eight spindle speeds for all except the 1D machine, which has infinitely variable speeds; 5-inch quill adjustment for the 1D and 1E machines; and No. 40 standard taper in spindles of all except the 1B machine.

Circle 604 on Readers' Service Card



Cincinnati H-V Toolmaster milling machine with power feed for table



**"THIS LUBRICANT
PRACTICALLY
ELIMINATED
BEARING
REPLACEMENTS"**

Says- C. O. SPARKS, INC.
& Mundo Engineering Co. of Los Angeles, Calif.

"Prior to using LUBRIPLATE, we were replacing shaker screen bearings within 60 to 120 days due to lack of or faulty lubrication. Since we started using LUBRIPLATE seven years ago, we have only replaced two shaker screen bearings and these because of natural wear. We now use LUBRIPLATE for general lubrication throughout our plant."

W. T. Ellington, President
Mundo Engineering Co.

**REGARDLESS OF THE SIZE AND
TYPE OF YOUR MACHINERY,
LUBRIPLATE GREASE AND
FLUID TYPE LUBRICANTS WILL
IMPROVE ITS OPERATION AND
REDUCE MAINTENANCE COSTS.**

LUBRIPLATE is available in grease and fluid densities for every purpose... LUBRIPLATE H. D. S. MOTOR OIL meets today's exacting requirements for gasoline and diesel engines.



For nearest LUBRIPLATE distributor see Classified Telephone Directory. Send for free "LUBRIPLATE DATA BOOK"... a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.



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HAS OVER **1001**
GUN DRILLS IN STOCK



NOW AVAILABLE FROM STOCK
ALL SOLID CARBIDE TIPPED
Dias. in every 1/64" increment

Size-Dia.	Length	Driver
.1250" to .5000"	10", 16", 22"—all dias. 28", 36"—most dias.	3/4" x 2 3/4"
.5156" to .7500"	16", 22", 36"	1" x 2 3/4"
.7656" to 1.0000"	22", 36"	1 1/4" x 2 3/4"

IMMEDIATE SHIPMENT
Also custom made Gun Drills in all dias.
up to 2" in any length within dia. limits
—ON NORMAL DELIVERY

ELDORADO • MILFORD

...there's ONE to LOWER YOUR HOLE COSTS!

ELDORADO'S constant inventory of popular size GUN DRILLS is keyed to the needs of the industry, designed to the most exacting specifications! Made to produce economically, straight, round, accurately located, finely finished holes . . . FASTER, in One Single Operation.

Our years of accumulated GUN DRILL making experience and knowledge, plus a complete research and engineering department are yours to take advantage of.

Get these important benefits with ELDORADO

- The world's largest manufacturer of GUN DRILLS—exclusively.
- A complete choice of sizes, lengths, types.
- Eliminate secondary operations—reaming, honing, grinding.
- Save your company money by reducing "cost-per-hole."
- Drill most materials—aluminum, cast iron, brass, tool steel, stainless, etc.
- Drill any shaped part to any depth (sometimes interrupted holes or across existing holes).
- Drill shallow or deep holes to precision tolerances.

Since these extras cost you no more...
your best bet is an ELDORADO GUN DRILL



ELDORADO specialized engineers, backed by research facilities are available to assist you on special "HOLE" problems. **WRITE TODAY!**

Specializing 100% in Gun Drills and Related Tools.



ELDORADO TOOL & mfg. corp.

348 BOSTON POST ROAD • MILFORD, CONN.

Starrett Superprecision Dial Indicators

Two new superprecision dial indicators introduced by the L. S. Starrett Co., Athol, Mass., will have an accuracy of plus or minus 0.0005 inch for the 0.015-inch total



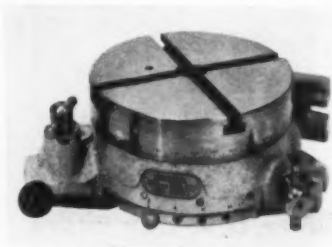
Starrett dial indicator

range (two and one-half turns). The Starrett No. 25-109 is a balanced dial indicator with a range of 0 to 3 to 0, one revolution 0.006 inch and total range of 0.015 inch. Starrett No. 25-209 is a continuous dial model, reading 0 to 6, one revolution 0.006 inch and total range of 0.015 inch. Both indicators are furnished with jeweled bearings.

Circle 605 on Readers' Service Card

"Universal Speedi-Spacer"

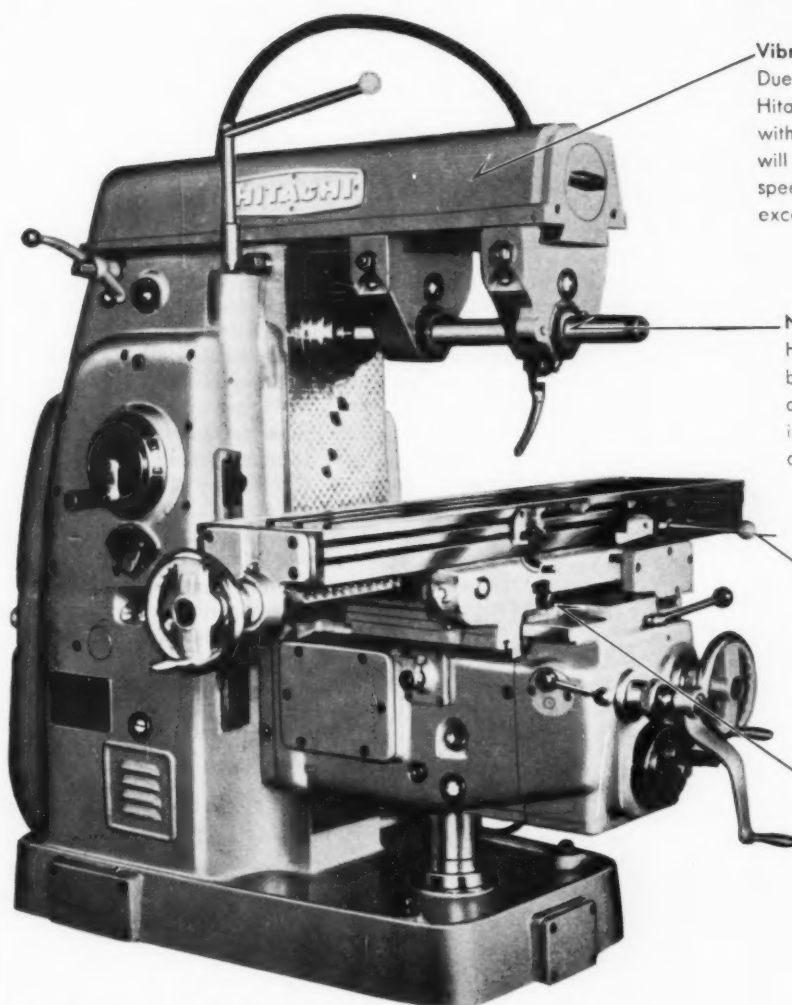
A new model precision Universal Speedi-Spacer, for use on milling, drilling, grinding, and other tool-room and production machining operations is announced by the Universal Vise & Tool Co., Parma, Mich. This spacer features a quick-action actuating lever and a choice of seven different divi-



Precision "Speedi-Spacer"

HITACHI

NO. 2 ML MILLING MACHINES



Vibration Damping Device

Due to a vibration damping device of Hitachi's exclusive design contained within the over-arm, minimum vibration will be set up even during higher speeds and feeds operation, so that an excellent finished surface is obtained.

New-Type Arbor Support Bearing

Hitachi's unique super precision-type bearing, a combination of plain metal and needle bearing, is incorporated into the machine to enable high speed cutting with high precision results.

Mono-Lever Control System

Hitachi's unique Mono-lever Control System makes the operation simple and easy. Table-feeding too can be performed with ease.

Backlash Eliminator of Lead Screw

As the use of two independent nuts eliminates backlash on the table feed screw, smooth down-cutting can be effected.

No. 2 ML Plain Milling Machine

SPECIFICATIONS :

- 53 1/8" × 10 1/16" Table
- 28" Longitudinal Traverse
- 16 Table Feeds 1/16" — 78 3/4"/min.
- 16 Spindle Speeds 25 — 1,500 r.p.m.
- 7.5 h.p. Main Motor

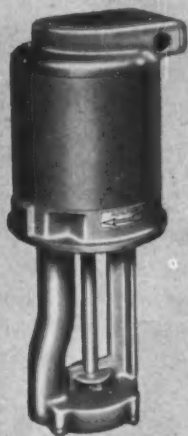


Hitachi, Ltd.

Tokyo Japan

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FIRST!
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Gusher COOLANT PUMPS

The original motor driven centrifugal machine tool coolant pumps.

First precision made dynamically balanced coolant pumps — comparable in workmanship to the machine tools they serve.

First ball-bearing pre-lubricated coolant pumps requiring no seals . . . no priming . . . minimum maintenance.

First with split-second coolant flow from the moment that the machine is turned on.

Follow the leading machine tool builders . . . specify Gusher Coolant Pumps on your machines.

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sions in the standard model. By changing the selector button, the user has a choice of two, three, four, six, eight, twelve, or twenty-four divisions, without the installation of special masking plates or block-outs. If other divisions are required, special master plates can be furnished to give any selection desired. This Speedi-Spacer is available with T-slotted platen, plain platen, or chuck. Pictured is the T-slotted platen type. Platen models are 9 inches in diameter. An 8-inch chuck is regularly furnished. Divisional ac-

curacies of 40 seconds or better are obtainable. After indexing has been accomplished, the Speedi-Spacer automatically locks. Also provided is a special clutch type lock to prevent any deviation or offset during machining operations. The spacer can be used in either the vertical or horizontal position. Two actuating levers are provided: one long, for standard operations, and one short, for close-space requirements. With plain platen the spacer has a total height of 4 inches.

Circle 606 on Readers' Service Card

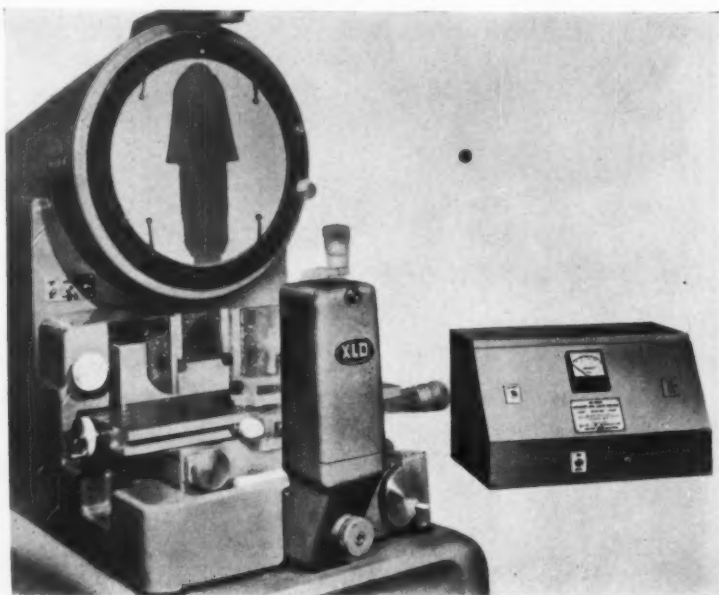
Arc Light Developed to Aid Optical Inspection

Since screen illumination in optical projectors diminishes as the magnification is increased, an intensified light source is desirable when higher magnifications are used. Mercury-arc light equipment is now available to give greater clarity and sharpness of the image, according to an announcement by Optical Gaging Products, Inc., Rochester, N. Y., national sales and service organization for projectors manufactured by the Ex-Cell-O Corporation, Detroit, Mich.

Contour projectors built by Ex-Cell-O now may be purchased

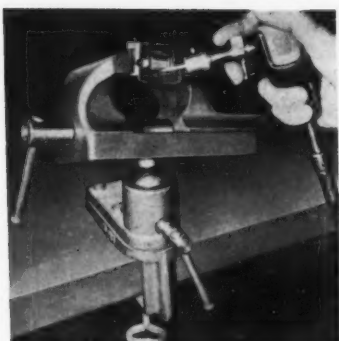
with mercury-arc light equipment, and existing projectors manufactured by Ex-Cell-O and those formerly made by Kodak can be easily converted. The mercury arc light, having an intrinsic brightness forty-five times that of a standard tungsten filament, is recommended for use at magnifications of 20× and over on 14-inch projectors and 50× and over on 30-inch projectors. The new arc light also can be used at lower magnifications by setting a switch on the power-supply unit to "Low Intensity."

Circle 607 on Readers' Service Card



Mercury-arc light for Ex-Cell-O contour projectors announced by Optical Gaging Products, Inc.

Circle page number on Readers' Service Card



Engis Tilt-Swivel Vise Clamp

Tilt-Swivel vise made by Engis Equipment Co., Chicago, Ill., equipped with recently developed bench clamp that makes possible rapid mounting of the vise and changing of its location on the bench by merely loosening the clamp screw. The ball joint of the vise permits swiveling through 360 degrees and tilting to 30 degrees up or down in any position. The new clamp provides even faster, easier setup for such operations as precision filing, drilling, reaming, grinding, or finishing. Work is held securely in the position most convenient to the operator, and with the clamp accessory, the entire assembly can be quickly moved from one position to another. Clamps are provided for both the large vise and the small one. Also available are separate serrated tool-steel jaws that are interchangeable with the unserrated jaws with which the vise is equipped.

Circle 608 on Readers' Service Card



Miniature Valves for Oil-Hydraulic Systems

Miniature directional valves for oil-hydraulic systems of a new line developed by Vickers Incorporated, Division of Sperry Rand Corporation, Detroit, Mich. These valves are designed for use in small-volume systems for such applications as jig positioning and clamping, hydraulic gear shifting

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... Call the STANDARD Distributor in your area, he will show you a variety of TWO-, FOUR- and SIX-FLUTE, Double or Single End Mills ...

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CLEVELAND 14, OHIO

BRANCH WAREHOUSES IN: NEW YORK • DETROIT • CHICAGO • DALLAS • LOS ANGELES • SAN FRANCISCO



**For rugged Die Set Performance
...there's nothing like a DANLY**



On those particularly tough jobs, there's nothing like a Danly Die Set for rugged, dependable performance. Even on longest production runs, Danly Die Sets prevent die shifting, protect dies. Turn out better, burr-free parts, too — and more of them between grinds. And with new Precision Pilot Guide Posts now available on all Danly Die Sets, assembly and dis-assembly are faster and easier than ever. If your needs demand smooth performance under most rugged conditions, depend on a Danly — either a standard or a special Danly Die Set designed to your specific requirements.



New literature tells how Danly's new PRECISION PILOT GUIDE POSTS assure perfect alignment for fast, easy die set assembly. Write for your copy.



PRECISION PRESSES, DIE SETS AND DIEMAKERS' SUPPLIES

DANLY

DANLY MACHINE SPECIALTIES, INC., 2100 South Laramie Ave., Chicago 50, Illinois

and clutching on machine tools, and venting on hydraulic-system relief valves. They are suitable for operation at pressures up to 1000 psi and have a maximum capacity of 2 gallons per minute. Simple, long-life alternating- and direct-current solenoids, with low current consumption, are available in all standard voltages. These gasket-mounted valves, designated DIL, are offered as four-way valves in both single- and double-solenoid models, and are available with a variety of spool types to suit operating requirements. They include alternate 1/8-inch pipe-thread cylinder-port connections.

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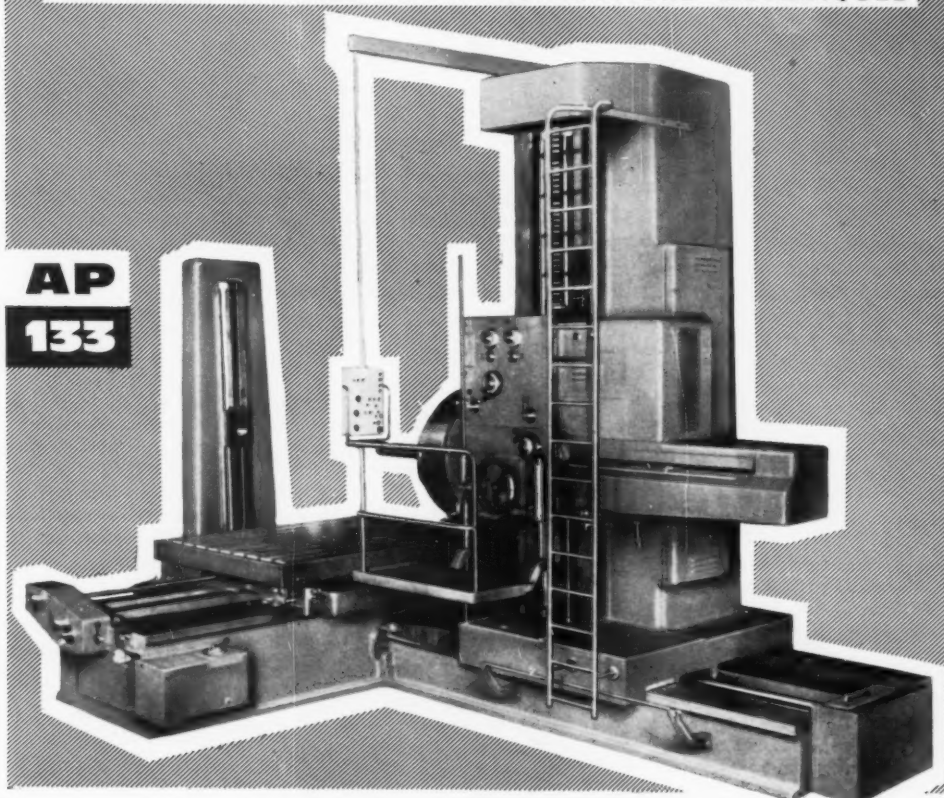


Osborn Industrial Brushes

KEB wire brushes with bridles designed to assure faster cut and longer life for metal finishing and cleaning, made by the Osborn Mfg. Co., Cleveland, Ohio. The brushes, equipped with removable bridles, compress the brush face for a greater cut and reduce flare. They are especially designed for use on high-speed air and electric tools. As in all Osborn KEB and CUP brushes, the new tools are filled with special-analysis steel wire to withstand severe usage in shipyards, railroad shops, structural-steel shops, and petroleum plants which need heavy-duty metal-cleaning tools in the range of medium to large surfaces. The bridle feature of the new KEB line is easily removable after partial brush wear in the following typical applications: weld-scale removal, tank and drum cleaning, corrosion and rust removal, cleaning railroad car axles prior to Magnaflux testing, structural-steel cleaning and paint removal, burr removal on heat-exchanger tubes, and pipe and pallet cleaning. The brushes are available in 2 1/2-, 3 1/2-, 4-, and 5-inch diameters and a wide range of wire sizes.

Circle 610 on Readers' Service Card

SOCIÉTÉ ALSACIENNE DE CONSTRUCTIONS MÉCANIQUES



PLANER TYPE BORING AND MILLING MACHINE remote controlled

Spindle diameter	130 mm (5.11")
Vertical traverse of headstock	2.000 mm (78.7")
Work table dimensions	1.800 x 2.200 mm (70.9 x 86.6")
Transverse traverse of table	3.000 mm (118")
Power of main motor	27 HP

GRAFFENSTADEN WORKS (BAS-RHIN) FRANCE

For more information, write to S.A.C.M., 3 Channing Place, Cambridge 38, MASS., Tel. EL. 4-8043
or to S.A.C.M. Graffenstaden - Bas-Rhin (France) 156, route de Lyon - Tél. : Strasbourg 34.92.00

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Universal combination millers
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Base type production millers
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Radial boring machines
Single column vertical boring mills
Boring and milling machines
- table type
- floor type
- planer type
Ram-type milling and boring machines

California, Oregon, and Washington

BURGMASER CORPORATION, Gardena, Calif., has established new sales offices at 4908 Lincoln Ave., Chicago 5, Ill., and 86 N. Maple Ave., Newark, N. J. WILLIAM McAVAY has been made sales manager, headquartered in the East, and JOHN MORRIS, assistant sales manager, headquartered in Michigan. PHIL DENU is eastern office manager and general service manager. New members of the sales engineering staff include: RUSSELL BARRY, Los Angeles, Calif.; DON HARRIS, Chicago; PAT FITZHARRIS, Chicago; and ALLEN BURROWBRIDGE, New Jersey.

JOHN P. SHARP has been named western regional manager for DENISON ENGINEERING DIVISION, AMERICAN BRAKE SHOE CO., Columbus, Ohio. In his new post, Mr. Sharp will supervise Denison sales, engineering, and services on hydraulic presses, pumps, controls, and systems in the entire western region. He will have headquarters in the company's west-coast regional office at 1651 E. El Segundo Blvd., Hawthorne, Calif.

RIVERSIDE-ALLOY METAL DIVISION, H. K. PORTER CO., INC., Riverside, N. J., has opened a new west-coast district office, headed by WILLIAM J. REED. The territory includes California, Oregon, and Washington. Offices for the newly activated district will be maintained at the Porter products distribution center at 6900 E. Elm St., Los Angeles, Calif.

W. B. BURKETT has been promoted to the position of vice-president and general manager for the Los Angeles, Calif., division of McCULLOCH CORPORATION. Mr. Burkett will be responsible for the engineering, manufacturing, sales, and quality-control functions of the division.

HYDRAULIC & AIR EQUIPMENT Co., Portland, Ore., has been an-

nounced as a dealer representing the DENISON ENGINEERING DIVISION, AMERICAN BRAKE SHOE CO., Columbus, Ohio. The firm will represent Denison in the states of Washington, Oregon, Idaho, Montana, and Wyoming.

JOSEPH T. RYERSON & SON, INC., Chicago, Ill., has just completed a 13,000-square-foot addition at its Seattle, Wash., steel and aluminum service plant. This has permitted the company to consolidate all of its Seattle operations at 1200 Fourth Ave. S.

Michigan, Minnesota, and Wisconsin



William I. McClelland, general sales manager, Winter Bros. Co.

WILLIAM I. MCCLELLAND has been appointed general sales manager of WINTER BROS. CO., Rochester Mich., tap and die division of NATIONAL TWIST DRILL & TOOL CO. Mr. McClelland joined the parent company in 1941 and held several production positions. He joined Winter Bros. in 1947 in the Detroit sales office, and became assistant sales manager in 1950.

As part of a planned diversification program in its general field, DETROIT BROACH & MACHINE CO.,

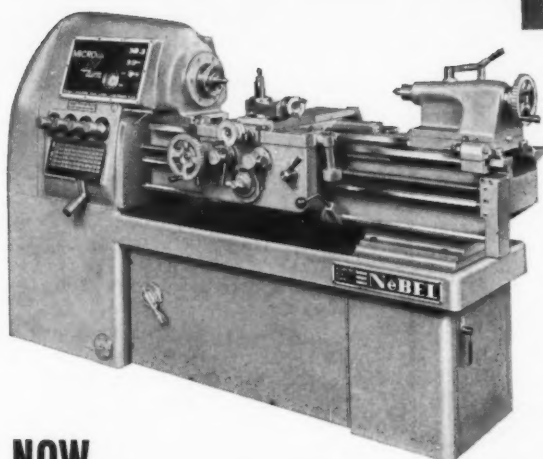
Rochester, Mich., has acquired exclusive licensing rights to a system of hydraulic control, the application of which initially may bring about far-reaching cost reductions in many small and large plants engaged in machining operations. The company has formed a new sales division, under the direction of S. R. CUDNOHUFKY, the inventor and developer of the system. The new division will immediately market a production tested unit that makes use of the system to convert almost any machine tool in use to a high-precision tracer machine for handling either short-run or high-volume production.

BENDIX CORPORATION, Industrial Controls Section, Detroit, Mich., has acquired an additional plant for the expansion of engineering and manufacturing facilities, with an increase of over 50 per cent in production capacity.

E. L. KAPERNAROS has been appointed manager—diamond application engineering for the METALLURGICAL PRODUCTS DEPARTMENT, GENERAL ELECTRIC CO., Detroit, Mich. Mr. Kapernaros has been with



E. L. Kapernaros, manager—diamond application engineering, Metallurgical Products Department, General Electric Co.



NOW...
CONTINUOUSLY VARIABLE RANGE OF SPINDLE SPEEDS
WITH CONSTANT HORSEPOWER THROUGHOUT

Now, by simply pressing a button until the desired speed is indicated on the direct-reading tachometer, you can select any spindle speed from 43 to 3500 RPM.

The new Micro-Turn features exclusive Nebel coaxial headstock spindle design plus mechanical beltless type variator drive unit (5 HP), which delivers constant horsepower throughout the entire range and maintains drive output speed within two-tenths of one percent. This assures maximum torque at low speeds for heavy cutting and ultra fine finish at highest speeds, with supreme balance and minimum vibration. Built-in positive torque responsive mechanism prevents slippage under starting or shock loads.

Other features include:

- exclusive feed converter unit, located in apron, providing simple conversion from standard to optional feed ranges without affecting standard thread ranges;
- double-wall, one-piece totally enclosed apron;
- fail-safe pressure lubrication to headstock, gear box and end gearing;
- pressure lubrication to carriage and cross slide ways provided by pump located in apron; one-shot plunger to lubricate cross slide ways when carriage is stationary;
- choice of manual or automatic coolant operation.

For the complete, illustrated story on the revolutionary MICRO-TURN, write today for your copy of Bulletin No. 222. Nebel Machine Tool Corporation, Lathe Division, 3410 Central Parkway, Cincinnati 25, Ohio.

NEBEL
MICRO-TURN
 HIGH SPEED PRECISION LATHE



Winter Brothers fluteless 'Rocket' Taps produce superior threads in materials such as aluminum, brass, copper, ductile steel and die castings by chipless forming, rather than by cutting. Because these taps actually displace metal without removing it, no chips are formed to clog flutes and cause tap breakage. Resharpener is virtually eliminated; longer tool life is assured. Formed threads are extremely accurate, have an excellent burnished finish and offer maximum strength.

'Rocket' Taps are stocked by your local Winter Distributor. Call him today for complete information. Or, write for our free, informative brochure on 'Rocket' tapping.

WINTER BROTHERS COMPANY

Rochester, Michigan, U.S.A.

DISTRIBUTORS IN PRINCIPAL CITIES. BRANCHES IN NEW YORK
CHICAGO • DALLAS • SAN FRANCISCO • LOS ANGELES



Choose from
Winter's Wide Line of
Taps, Dies and Gages

CALL YOUR WINTER DISTRIBUTOR

the department for five years. For the past two years he has been serving as an application engineer for the Diamond Product Section.

W. J. KOCHER, JR., has been appointed assistant manager in charge of engineering services for the Minneapolis, Minn., district of AIR REDUCTION SALES CO., a division of AIR REDUCTION CO., INC., New York City. Mr. Kocher has been associated with Airco since 1954.

A new company, SIMPLEX TOOL CORPORATION, Butler, Wis., has been formed by the principals of NORTHWEST TOOL & ENGINEERING CO. and WISCONSIN DRILL HEAD CO., also located in Butler. S. POHLHAMMER, president, and J. E. SCHULTZ, secretary-treasurer and their associates have purchased the inventory, equipment, trade name, and other assets of the SIMPLEX MACHINE TOOL CORPORATION. The new company will manufacture, sell, and service the complete line of Simplex boring machines that have been produced and marketed to industry for the past thirty years. P. O. WERNICKE will be chief engineer and sales manager for the new firm.

New England

BARDEN CORPORATION, Danbury, Conn., has announced the formation of a new division to design, manufacture, and market precision mechanisms. The new Barden Research Precision Mechanisms Division, a separate facility, will also conduct company-sponsored and contract research on ball bearings and related devices. BRUCE L. MIMS, vice-president, has been appointed general manager of the division.

WILLIAM M. TAUL, JR., has been named general sales manager of ROBERT E. MORRIS CO., West Hartford, Conn. During the years preceding his promotion, Mr. Taul served the company as a sales engineer in the Vermont, New Hampshire, and western Massachusetts territory and as a staff assistant to the president of the company.

G. W. LATESTTE has been appointed director of manufacturing equipment for STANLEY WORKS, New Britain, Conn., in charge of research and advanced development, design, and construction of automatic machinery and automated production lines. He has been chief corporate design engineer for the past year.

CUSHMAN CHUCK CO., Hartford, Conn., has named EDGAR W. BLAKE

and MARSHALL C. EARLEY to the sales department of the company. Mr. Blake and Mr. Earley have been employed by Cushman since 1939.

Machine Tool Division of BROWN & SHARPE MFG. CO., Providence, R. I., has made the following appointments: EARL P. LEEDS will assume new duties as superintendent of the milling and grinding machine group. He will continue to direct Federal Government sales. JAMES F. ROWLEY has been appointed sales director of turret drilling machines. W. HOWARD CLASSEN will be in charge of turret drilling application engineering. ARNOLD N. HELLEWELL has been named sales director in charge of screw machine sales.



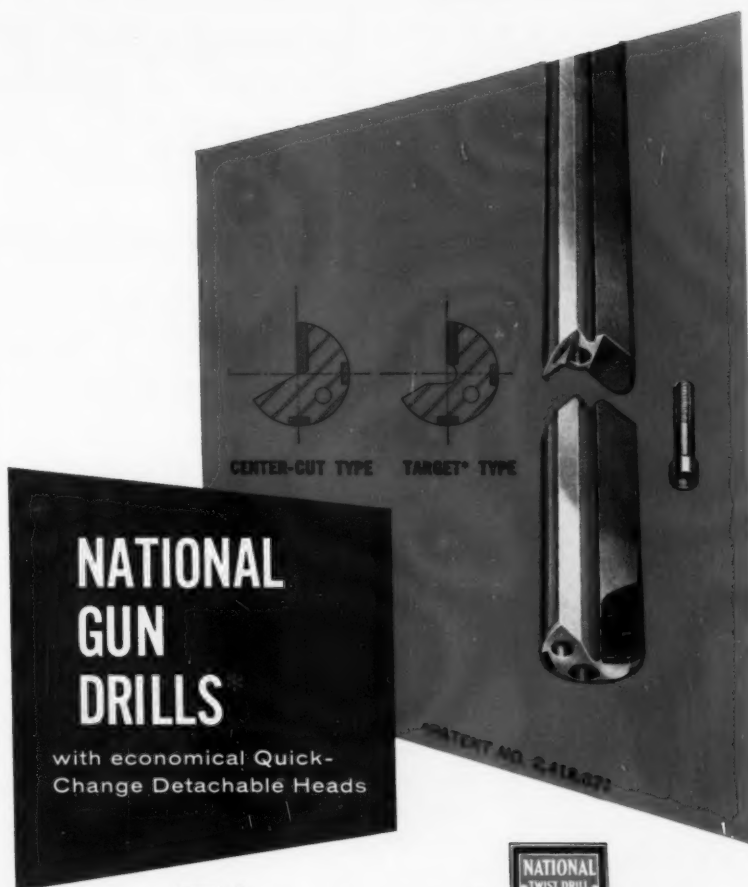
William E. Millikin, treasurer of Fellows Gear Shaper Co.

FELLOWS GEAR SHAPER CO., Springfield, Vt., has elected WILLIAM E. MILLIKIN treasurer and a member of the board. He succeeds FREDERICK P. DASHNER, who has retired.

New York and New Jersey

The appointment of JAMES M. KENNEDY, JR., as assistant chief engineer has been announced by REVERE COPPER & BRASS INC., New York City. He will serve as assistant to WILLIAM T. BERTIER, assistant manufacturing manager and chief engineer, in Revere's executive offices in New York. Mr. Kennedy has been chief engineer of the Rome (N. Y.) division since 1957.

CHICAGO PNEUMATIC TOOL CO., New York City, has announced the election of GUY J. COFFEY as chairman of the board and chief executive officer of the company. NORMAN READMAN has been elected presi-



NATIONAL GUN DRILLS

with economical Quick-Change Detachable Heads

National



Quick-Change Detachable Heads, an exclusive, patented feature of National Gun Drills offer maximum production economy, assure less drilling downtime. Available on both Center-Cut and Target type Gun Drills larger than 17/32" in diameter, the Quick-Change design allows resharpening or replacement without removing the drill shank from the machine.

Target Gun Drills permit straighter, deeper drilling to closer tolerances. A solid core is formed that acts as a continuous center guide in the hole being drilled with a resulting increase in accuracy.

Center-Cut Gun Drills are recommended for peak efficiency on certain applications such as blind-hole and interrupted-hole drilling. Call your National Distributor for complete information. Or, write for our Gun Drill Manual.

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National's Parade of
Plus Products



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STAFF...
and the
STOCK*



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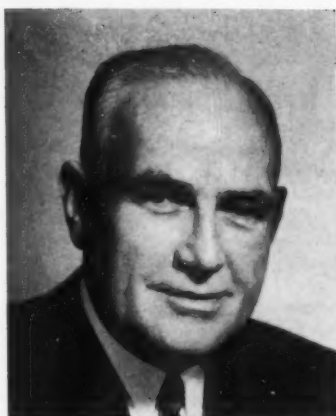
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LOVEJOY
& COMPANY, INC.**

138 Sidney St., Cambridge 39, Mass.



Fabian Bachrach

Guy J. Coffey, chairman of the board and chief executive officer, Chicago Pneumatic Tool Co.

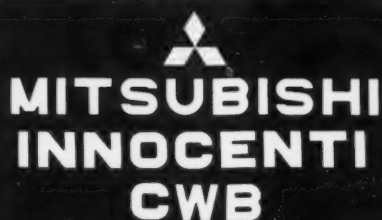


Norman Readman, new president of Chicago Pneumatic Tool Co.

dent to succeed Mr. Coffey. Mr. Readman was formerly managing director of all overseas operations of the company. Other appointments include THOMAS F. NOONAN as vice-president and comptroller and CARRA L. LANE as vice-president and manager of plant operations.

FREDERICK H. FIPPINGER, factory representative for CUSHMAN CHUCK Co., Hartford, Conn., will also represent the company's line of air, manual, and special chucks; power wrenches; and faceplate jaws in northern and western New York State.

JOHN E. ALDEBORGH has been elected executive vice-president of STANDARD GAGE Co., Inc., Poughkeepsie, N. Y. This promotion follows his thirteen years of experience in every phase of the company's manufacturing, engineering, and research departments, including his



milling boring and combined machine

**Universality, productivity
and easy handling....**

are characteristics of INNOCENTI-CWB milling, boring and combined machine.

MITSUBISHI ZOSEN (Mitsubishi Shipbuilding & Engineering Company) manufacture and distribute the FA 140/95 type (dia. of spindle 140 mm for milling, and 95 mm for boring) of this universally-known machine, licensed by INNOCENTI S.G. of Milano.

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• **France:** Société d'Etudes de Machines Outils, Outillages et Accessoires, Paris • **Switzerland:** A. Ritschard Machines-Outils SA, Geneva
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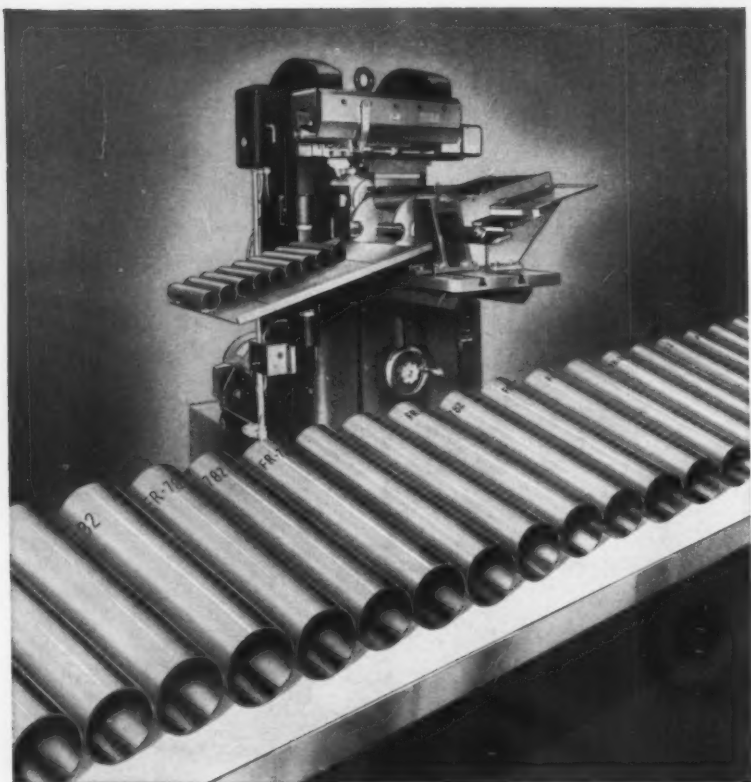
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Machine tool manufacturing division
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Here's a tough marking job—thin walled tubes would collapse under normal marking pressure. The problem was solved using a spider and reciprocating arbor type feed in a Model 175 . . . marking at a rate of 3,000 per hour.

Production marking of parts—any size or shape—is a Schmidt specialty. Why not call in a Schmidt engineer! He can help you plan a cost saving marking system.

COMPLETE LINE OF MARKING EQUIPMENT



Whatever you need in marking, GTS handles the complete job—dies, machinery and tooling. Let our marking specialists handle your problem. Send today for Catalog No. 18.



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Engraved Marking Tools • Nameplate Marking Equipment
Embossing Dies • Special and General Purpose Marking Machines

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John E. Aldeborgh, newly elected executive vice-president of Standard Gage Co., Inc.

most recent five years as vice-president in charge of sales.



Herbert T. Kerr, assistant treasurer of U.S. Industries, Inc.

HERBERT T. KERR has been named assistant treasurer of U.S. INDUSTRIES, INC., New York City. Mr. Kerr joined the company in 1955 as an accounting supervisor, and was made manager of systems and controls in 1957. He was assistant to the treasurer prior to his present appointment.

AIR REDUCTION SALES CO., a division of AIR REDUCTION CO., INC., New York City, has announced the following: W. B. MOEN has been made manager of the Cryogenic Engineering Department in Plainfield, N. J. In his new post, Mr. Moen will be responsible for the design and construction of major air separation and related cryogenic plants. WILLIAM J. GREENE has been appointed associate director—physical research, heading a new division of the Cen-

re-li-a-ble:
That which can
always be counted
upon to do what
is expected or
required

CRATEX RUBBERIZED ABRASIVES

*Micro-deburring, Smoothing,
Cleaning, Polishing*

Cratex reliability lowers costs

You can count on every Cratex item to perform just as you expect it to—exactly as the last one did and as the next one will. This is the key to efficiency in micro-deburring, smoothing, cleaning and polishing. **YOU SAVE TIME** because you know just what to expect in performance without experimenting or compensating. **YOU SAVE REJECTS** because with Cratex no unexpected irregularities occur to spoil work pieces.

WHEELS • POINTS • BLOCKS • STICKS • CONES
in 4 grit textures for power or manual application. Sold through leading industrial supply distributors.

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CRATEX

MANUFACTURING COMPANY, INC.

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For more data, circle Item 209A on Readers' Service Card



**DYKEM
STEEL BLUE**
*Stops Losses
making Dies and
Templates*

Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company letterhead

THE DYKEM COMPANY
2303R North 11th St. • St. Louis 6, Mo.

CUT SCRAPER TIME
END NIGHT CLEANUP & MORNING REBLUING

DYKEM HI-SPOT BLUE No. 107 is used to locate high spots when scraping bearing surfaces. As it does not dry, it remains in condition on work indefinitely, saving scraper's time. Intensely blue, smooth paste spreads thin, transfers clearly. No grit; noninjurious to metal. Uniform. Available in collapsible tubes of three sizes. Order from your supplier. Write for free sample tube on company letterhead.

THE DYKEM CO., 2303R NORTH 11TH ST., ST. LOUIS 6, MO.

For more data, circle Item 209B on Readers' Service Card

CAMS
ALL TYPES
MADE TO
YOUR
SPECS!

**CAM CALCULATING
SERVICE**

Write for
catalog 55-C

EISLER ENGINEERING CO., INC.
Chas. Eisler, Jr., President

738 South 13th Street
Newark 3, New Jersey

For more data, circle Item 209C on Readers' Service Card
MACHINERY, July, 1961



**3-12 SEPT
BRUXELLES
1961**

**7TH
EUROPEAN
MACHINE TOOL
EXPOSITION**

Come to Brussels from September 3 to 12 to the 7th European Machine Tool Exposition. On display will be machine tools and related equipment produced by members of the European Committee for Cooperation of the Machine Tool Industries in Austria, Belgium, Denmark, France, West Germany, Great Britain, Italy, Netherlands, Sweden and Switzerland. In addition, Brussels is a center for many tours; convenient to Paris, Bruges, Antwerp, the Rhine valley and other centers of interest.

A catalog giving all information, including a list of the exhibitors classified by material produced, will be published in July and can be ordered now from the General Commissariat. Price, \$3 postpaid, registered airmail. Send for a copy now.

Make your hotel reservations now by contacting any **WAGONS-LITS//COOK** Agency. For information about the Exposition itself write:

GENERAL COMMISSARIAT

7th European Machine Tool Exposition

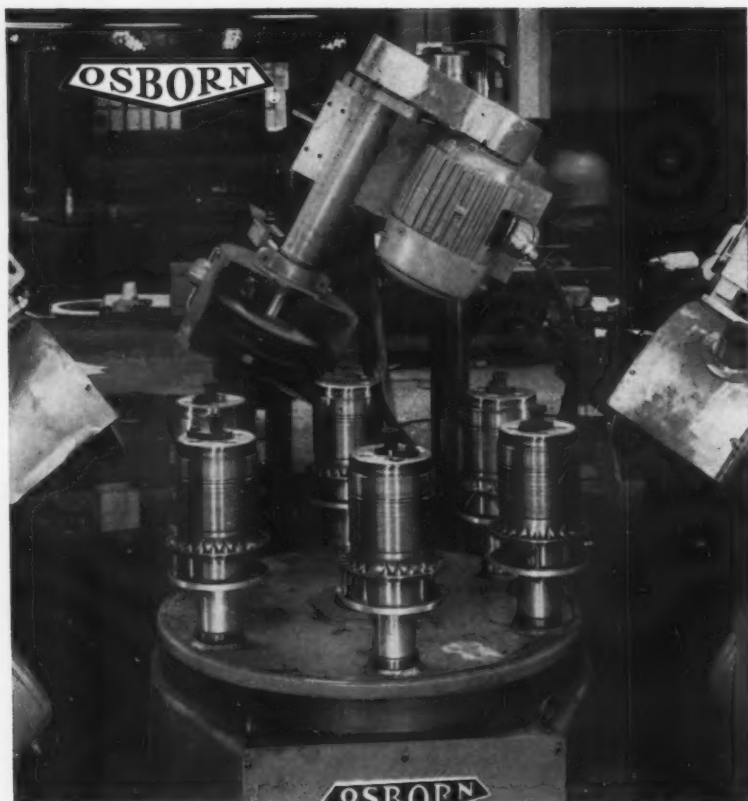
13, rue des Drapiers

Brussels 5, Belgium

Telephone: Brussels 13.25.62

Telegrams: Exmosycocom, Brussels

For more data, circle Item 209D on Readers' Service Card



THIS AUTOMATIC FINISHING OPERATION handles precision edge blending on aircraft engine cylinder barrels. Setup consists of an Osborn 6-station index table and three finishing heads equipped with Osborn Fascut[®] Brushes with deburring compound. Heads No. 1 and 3 each brush one minute clockwise and ccw to put .020" blend on edges of mounting holes. Head No. 2 brushes 1½ minutes cw and ccw to put .010" blend on top edge and O.D. thread ends.

EDGE BLENDING cylinders done 566% faster with OSBORN power brushing

Here's an aircraft manufacturer with a problem: specifications for these reciprocating engine cylinder barrels called for precision tolerances. Hand finishing rate: 3 parts an hour . . . too slow . . . too costly.

Today, an automatic Osborn Metal Finishing Machine handles the work . . . *power brushing* the parts rapidly, uniformly, economically. Rate: 20 an hour . . . *566% faster with exceptional quality control.*

It's another case-in-point of today's Osborn power brushes and brushing methods at work throughout industry solving tough metal finishing problems. An **Osborn Brushing Analysis**—made in your plant now at no obligation—can cut costs on *your* deburring, cleaning, polishing and precision blending operations. Write or call *The Osborn Manufacturing Company, Dept. D-65, Cleveland 14, Ohio. Phone ENdicott 1-1900.*



Metal Finishing Machines . . . and Finishing Methods
Power, Paint and Maintenance Brushes • Foundry Production Machinery



W. B. Moen, manager—Cryogenic Engineering Department of the Air Reduction Sales Co.



William J. Greene, associate director—physical research for the Central Research Laboratories of Air Reduction Sales Co.

tral Research Laboratories of the company in Murray Hill, N. J. GILBERT R. ROTHSCHILD is now assistant director—metallurgical development, also heading a new division of the Central Research Laboratories.

FRED LOPARDO has joined LELAND GIFFORD CO., Worcester, Mass., as sales engineer in the Brooklyn-Long Island, N. Y., area. He will maintain offices at 75 S. Orange Ave., South Orange, N. J.

Ohio and Illinois

VERNON B. JENSEN has been appointed district manager for the CLEVELAND TRAMRAIL and STEELWELD MACHINERY DIVISIONS of CLEVELAND CRANE & ENGINEERING CO., Wickliffe, Ohio, in the Cleveland, Toledo, and Detroit (Mich.) areas. Mr. Jensen previously was



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**REVERSIBLE
TAPPING
ATTACHMENTS**
have ball type drive!



The axial friction is extremely low, which makes highly accurate thread cutting possible at all times. The throw out clutch eliminates chatter and vibration. Compact design.

	SAR 50	SAR 100
Steel SAE 1035	#0-#8	#5-#10
Axial float	1/32"	1/16"
Recommended R.P.M.	1400	1000
Length	5 1/4"	7 3/4"
Max. dia.	1 3/4"	2 3/4"

Also, SAR-51 for Burgmaster.
Non-reversible attachments
with capacities from #0 to 2".

Write for illustrated brochure.
A few dealer territories still open.

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MACHINE TOOL CORP.

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For more data, circle Item 211A on Readers' Service Card



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are manufactured to advance standards in the paths of progress for uninterrupted service and offer greater durability. Our catalog #20 will guide your selection listing many standard sizes which can be supplied without any costly delays. May we be of service in supplying your requirements?

THE BALL & ROLLER BEARING CO.
DANBURY, CONN.

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**INDUSTRIAL
LUBRICATION
PRACTICE**

by Paul H. Hobson

A practical manual for the effective lubrication, bearing maintenance, and storage preservation of motors, engines, turbines, production machinery, machine tools and other industrial and marine equipment. \$8.00

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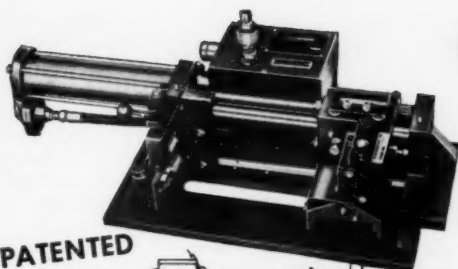
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MACHINERY, July, 1961



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with the Cleveland Tramrail distributor organization in San Francisco, Calif.

JAMES H. WOODWARD, Jr., has been assigned as field engineer in the Cincinnati, Ohio, office of DENISON ENGINEERING DIVISION, AMERICAN BRAKE SHOE CO., Columbus, Ohio. Mr. Woodward will carry out sales engineering assignments on Denison hydraulic pumps, motors, and controls in the southern Ohio-northern Kentucky area. He will be located at 6851 Plainfield Road, Cincinnati 36, Ohio.

LINCOLN ELECTRIC Co., Cleveland, Ohio, has announced the transfer of DAVID B. READER from Albany, N. Y., to the Dayton, Ohio, office. JACK B. PASKINS and JAMES W. ROSENTHAL have been appointed to Lincoln's staff of field engineers and assigned to the Albany and Pittsburgh, Pa., offices, respectively.

CHARLES T. BLAKE, director of engineering, WARNER & SWASEY Co., Cleveland, Ohio, has been elected president of the CLEVELAND ENGINEERING SOCIETY for the 1961-1962 term. Mr. Blake is the fifth

member of the Warner & Swasey organization to head the society.

DANIEL J. WILLIAMS, Jr., has been made manager of the Cleveland, Ohio, plant of PRODUCTO CORPORATION, Bridgeport, Conn. Prior to joining Producto, Mr. Williams was vice-president of CONNECTICUT TOOL & ENGINEERING Co., Fairfield, Conn.

DENISON ENGINEERING DIVISION, AMERICAN BRAKE SHOE CO., Columbus, Ohio, has named JOHN W. STERTZER midwest regional product manager, with headquarters at 7000 W. 63rd St., Chicago, Ill. In his new post, Mr. Stertzler will supervise special sales engineering projects relating to the application of Denison pumps and controls in the midwestern area. In addition, ROBERT D. ARTHURS has been made a field engineer for the division. Mr. Arthurs will handle sales of Denison hydraulic Multipresses in the midwestern area. He will also make his headquarters in the Chicago office of the company.

Pennsylvania and Maryland

CARPENTER STEEL Co., Reading, Pa., has appointed JOHN S. KLINE director of general services for the parent company. Succeeding Mr. Kline as general manager of the Alloy Tube Division, Union, N. J., is BARCLAY MORRISON. Mr. Kline's new duties include corporate planning and budgeting.

GABRIEL C. DANCH has been named a vice-president of the Western Design & Electronics Division of U.S. INDUSTRIES, INC., New York City. Mr. Danch will be in charge

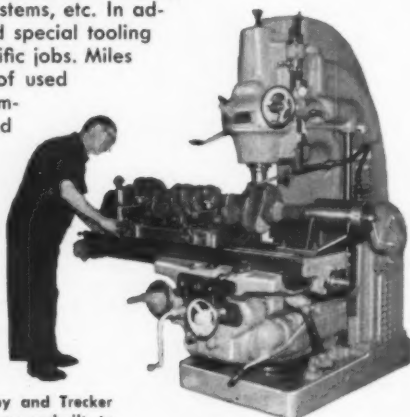


Gabriel C. Danch, vice-president of Western Design & Electronics Division, U.S. Industries, Inc.

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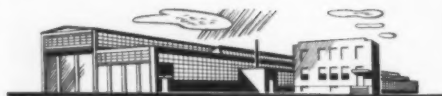
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3"11" Morris, late, extra clean

4"11", 4"13", 5"13", 6"17" American Hole

Wizards, all excellent

4"15", 5"17", 8"19" Fosdick Economax, all reasonable

6"19" Carlton, late, good

PLAIN CYLINDRICAL GRINDERS

16"x198" centers Cincinnati, 1942

16-25"x72" Landis, 1943

20"x72" Landis, heavy duty, 1945

24"x72" Landis Type F, Brand New, 1955

42"x72" Norton, latest

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12x30" and 14x102" Monarch, 1944 machines, hard beds

14x78" Lodge and Shipley, taper, extras, late

16x54" LeBlond, reasonable, late

18x30" and 18x54" Lodge and Shipleys, late

20"-40" and 25"-40" Nebel Gap Lathes, latest

27 1/2" swing, 336" centers Monarch, two carriages, late

25" raised to swing 36 1/2"x48" centers Monarch with tracer, 1954

27"x192" centers LeBlond, already rebuilt

30"x60" centers Monarch, extra heavy, very clean

36"x31" centers Niles, two carriages, reasonable

36"x11" centers Lodge and Shipley-older, very reasonable

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of operations at Silver Spring, Md. He was formerly manager of the company's Washington office.

Tennessee, North Carolina, and Florida

FRED D. WRIGHT Co. has announced the opening of its new modern tool and die plant, located at 707 Spence Lane, Nashville, Tenn. The 40,000-square-foot plant is equipped with a variety of metal-working equipment representing an investment of \$750,000.

G. C. WINGATE has been named assistant manager-sales for the Charlotte, N. C., district of AIR REDUCTION SALES Co., a division of AIR REDUCTION Co., Inc., New York City. Mr. Wingate will supervise the activities of all Airco salesmen and distributor merchandising representatives in the states of North Carolina, South Carolina, Virginia, eastern Tennessee, northeast Georgia, and the Bluefield area of West Virginia.

V. B. CASSILLY has been made assistant manager-sales for the Tam-

pa, Fla., district of AIR REDUCTION SALES Co., a division of AIR REDUCTION Co., Inc., New York City. In his new post, Mr. Cassilly will coordinate sales of Airco products in Florida and southern Georgia.

Texas and Oklahoma

The appointment of FRANK R. TICHY as manager of work order sales at the Houston, Tex., plant has been announced by JOSEPH T. RYERSON & SON, INC., Chicago, Ill. Mr. Tichy specialized in the sale of work order products and services beginning in 1957.

MARSHALL SUPPLY & EQUIPMENT Co., Tulsa, Okla., has been made a distributor for the complete line of Footburt machine tools by FOOTBURT Co., Cleveland, Ohio. The new distributor will provide Footburt sales, engineering, and service to industry throughout their exclusive territory of Oklahoma, southeast Kansas, southwest Missouri, and northwest Arkansas.

England

MADISON INDUSTRIES, INC., Providence, R. I., has announced the licensing of BIRMINGHAM TOOL & GAUGE Co., LTD., Birmingham, England, to manufacture and sell the full line of Madison tools and accessories in that country.

Coming Events

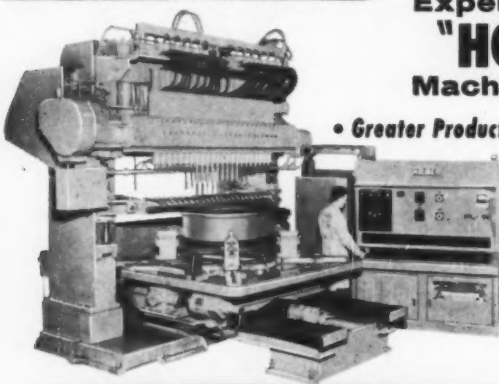
SEPTEMBER 28-29—Fourth Annual National Conference and Technical Exhibit of the American Production and Inventory Control Society, to be held at the Pick-Congress Hotel, Chicago, Ill. For more details, contact American Production and Inventory Control Society, 330 S. Wells St., Chicago 6, Ill.

OCTOBER 23-27—1961 Detroit Metal Show and ASM Materials Comparison Center, to be held in Cobo Hall, Detroit, Mich. For additional detail, contact William J. Hilty, exposition manager, American Society for Metals, Metals Park (Novelty), Ohio.

OCTOBER 23-27—Forty-Third National Metal Congress, presented by the American Society for Metals and eight participating organizations, to be held in Cobo Hall, Detroit, Mich. For more information, contact T. C. DuMond, manager, metal congresses, American Society for Metals, Metals Park (Novelty), Ohio.

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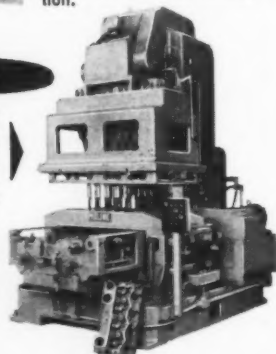
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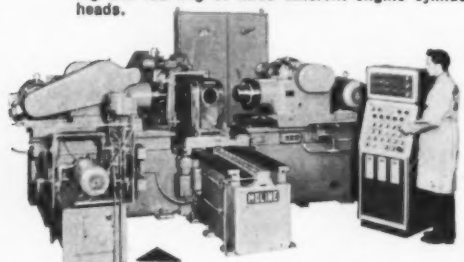
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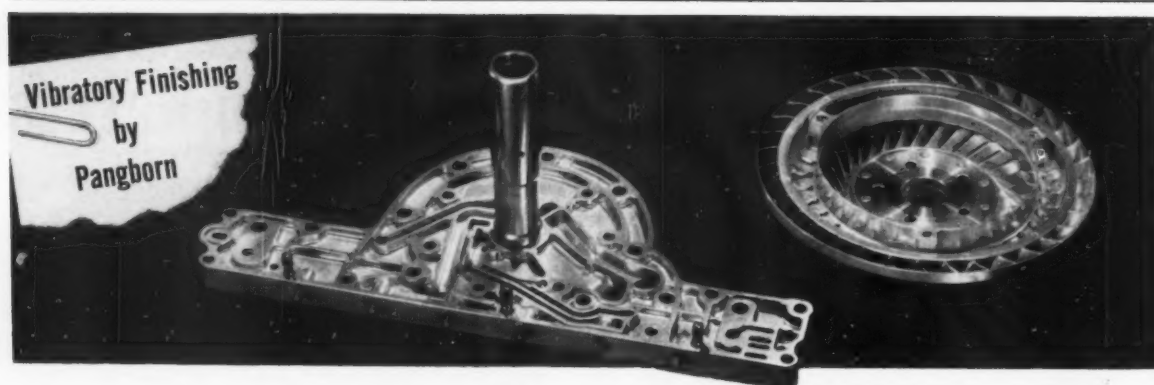
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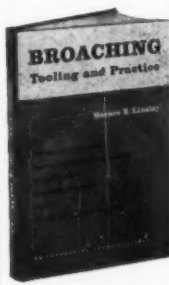
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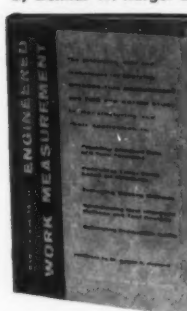
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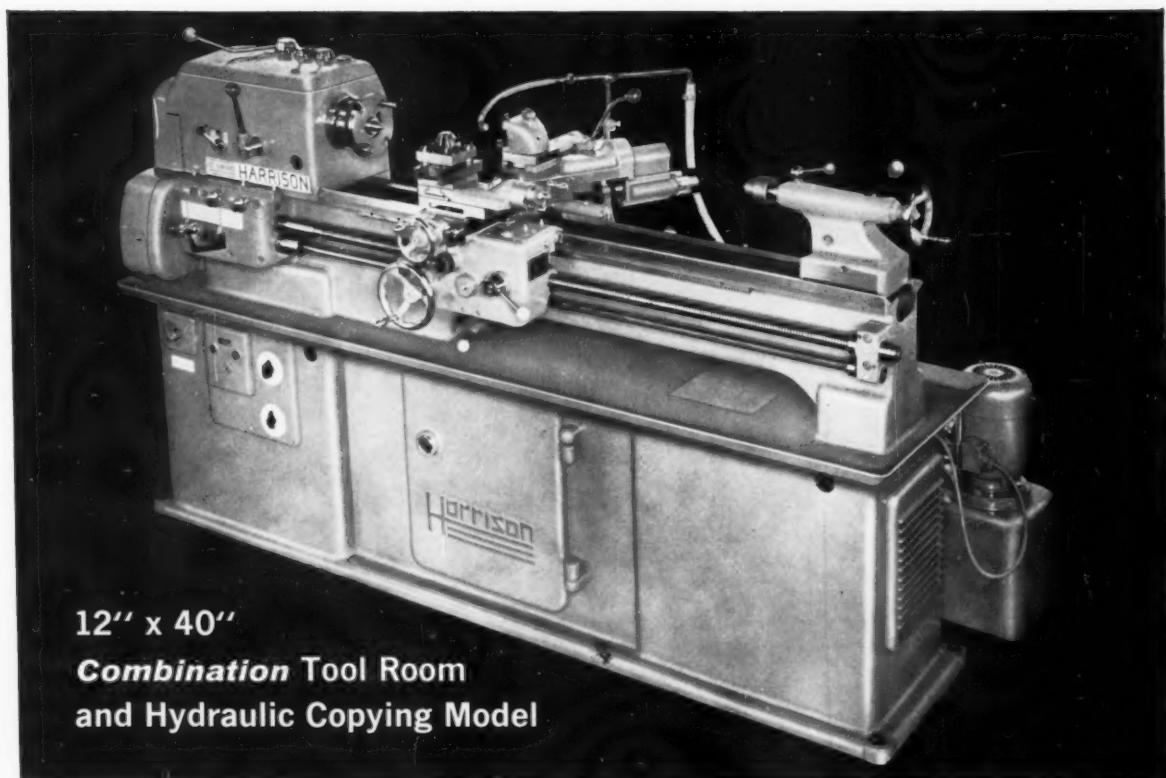
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